NATURE

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"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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THURSDAY, APRIL 1, 1920.

The Anti-dumping Bill.

THE Bill to prevent dumping and to establish a Special Industries Council to advise as to the promotion and assistance of special industries has just been introduced into the House of Lords by Lord Balfour of Burleigh, and, as might have been anticipated, met with a somewhat dubious reception from certain noble Lords who, faithful among the faithless, still bow the knee to the old gods of Manchester. *Autres temps, autres mœurs*. We seem to remember a time when the present sponsor of the Bill made the "happy despatch" rather than obey the behest of the chief apostle of Tariff Reform and Imperial Preference to follow the path he is now treading. But we live in changeful times, and events are apt to play havoc with principles. Lord Balfour of Burleigh is not by any means the only citizen who recognises that the altered economic conditions of the Empire and of the world are nowadays inconsistent with the *credenda* of the Cobden School.

It cannot be said, however, of the new departure that the Bill, after all, deals with a measure of any very great magnitude. Even if it becomes law it is not likely to have any immediate or world-wide consequence. As regards dumping, it is primarily aimed, of course, at our late chief adversary. The Germans, no doubt, would dump again if they could, or saw any advantage in so doing. But from all accounts they are not now in a position to consign any class or kind of goods at prices at which goods of the same class or kind are sold by them at home in the ordinary course of business. It is, therefore, in the highest degree unlikely that the Board of Trade would be called upon for many months, or even years, to come to prohibit their importation from Germany under the powers of the Customs Consolidation Act of 1876.

The present political and economic condition of that prostrate nation forbids any hope that she can for a long time yet, if ever, resume her old position as a great trading community. Her proletariat has now tasted power as never before, and conditions of production are altogether changed. It is certain that in the case of some commodities, sugar, for example, there is nothing to dump, and the prospect that there ever will be is very remote. But it must never be forgotten that Germany is not the only nation that might conceivably resort to dumping in the future, and after our bitter experience we cannot afford to let the future take care of itself.

The provisions of the Bill are very elastic, and the Board of Trade is to be entrusted with a fairly wide discretion as regards prohibition of entry. If the imported goods are shown to be necessary in the national interest they may be admitted under such conditions as the Board may order, and any such order must be brought to the notice of both Houses of Parliament. This would not preclude the Board from taking prompt action when necessary; but the Minister would of course be responsible ultimately to Parliament. As an interference with freedom of trade, even the reasonable safeguards involved in this measure will no doubt be fiercely opposed; and it remains to be seen what power the doctrinaires of the old school still retain. The plain man will find it difficult to see the snake in the grass.

The sections of the Bill dealing with the establishment of the Special Industries Council for the promotion and assistance of special industries are, however, of immediate and pressing importance, and it is to be hoped that, whatever may be the fate of the clauses directed to the prevention of dumping, this portion of the measure will not be sacrificed. It is concerned with matters which may be said to have originated out of and in consequence of the war, and to have been forced upon us in great measure by the action of our late enemies. It is notorious that for years prior to the outbreak of war Germany had by divers arts and cunning contrivance sought to hamper and restrain the development of our industries and to thwart the expansion of our commerce. Her methods at times, especially in foreign markets, had violated every principle of fair trading. Her practices were part of her policy of world-wide aggression—*Deutschland über alles*—no matter at what cost or at what sacrifice of commercial rectitude. It was that policy which produced, and probably precipitated, a war which practically every element of German nationality had conspired for a generation past to bring about. It was only on its outbreak that the extent and character of that conspiracy were realised, and that this country fully recognised how it had been tricked, and with what subtlety one after another of the things that count in the struggle which was contemplated had been "cornered" and impropriated. Chagrined as Germany was by our entrance into the war, it was untrue to say, as she alleged, that jealousy of her impending commercial supremacy was at

the bottom of our action. However disquieted and perturbed we might be with Germany's repeated acts of aggression and with the truculence and arrogance of her methods, strained trade relations would never have induced this Empire to draw the sword. That was not the issue which welded the English-speaking world together. But that Germany should have so imagined is intelligible. She had at least good cause for the supposition.

The special industries which the Bill seeks to promote and assist have originated, so far as this country is concerned, in great measure through and by reason of the war. We were compelled to take them up by sheer necessity. Certain of them were among the things of which the Germans had gradually acquired practically complete control for years past. All of them were necessary to our national welfare, and some of them, under the conditions of modern warfare, were essential to our national existence. Our late experience ought surely to have burnt the lesson into the national mind. Never again must we be dependent on outside sources for our medicaments and dyes, certain metals, magnetos, glassware, and optical instruments. These special industries —enumerated in the second schedule to the Bill— were in great measure started during the earlier years of the war. They are defined to be industries supplying commodities which are essential to the national safety, as being absolutely indispensable to important industries carried on in the United Kingdom, and which formerly were entirely or mainly supplied from countries outside these islands. They cannot be said to be firmly established as yet. Some of them, like the manufacture of synthetic dyes, have made extraordinary progress, and their permanence is only a question of time. Others are being developed with more or less rapidity. But every one of them is the subject of continued scientific inquiry and research, and it is the purpose of the projected measure to foster and protect them during this incubatory period.

To this end it is proposed to create a Council of not fewer than five and not more than nine persons of commercial and industrial experience, to be appointed by the President of the Board of Trade. Its duties will be to watch the course of industrial development and, in consultation with the Department of Scientific and Industrial Research and any other Government Department interested in any special industry, to advise the Board as to the promotion and assistance of the special industries named in the schedule to the Bill, and any other industry which, in the opinion of the Council, is a special industry in the sense already defined. It is required to examine any proposals made as to the promotion and assistance, or any suggestions as to the better organisation or management, of any special industry on the application of any Government Department interested, or any firm or person engaged, in any such industry, to advise the Board as to what steps, if any, should be taken by way of assistance to conserve or promote any special industry, and to indicate the terms upon which, in its opinion, such assistance should be given. It is further required to make an annual report to Parliament stating what has been the progress of any special industry to which State assistance has been given, and what recommendations have been made in respect to it. Lastly, any application made to the Board for State assistance by any firm or person engaged in a special industry shall be referred to the Council, together with any information in the possession of the Board as respects that industry, and the Board may require any firm or persons engaged in that industry to furnish any information which the Council may deem necessary under pain of fine or imprisonment.

These, no doubt, are somewhat drastic powers, but, it must be remembered, they are asked for in the interests of national security, and it is unlikely that in operation they will prove to be inconsistent with the proper interests of private trading. As the Council will be associated with the Department of Scientific and Industrial Research, we assume that it will exert a nurturing influence upon scientific work through which industries are created and developed. No one desires to assist an industry which is not itself endeavouring to grow by the use of knowledge, but when this intention is clearly manifested, the State may very well exercise the function of stimulating it or of removing obstacles to expansion. We are faced with the necessity for doing whatever is within our power to promote the establishment of new industries as a means of increased production, not only because our national position demands the use of progressive methods, but also to enable us to meet the vast expenditure which the war has entailed. We have regained in a measure the control of raw materials, and for their profitable use science must co-operate with industry, and both must be the objects of the fostering care of the State. The new measure seems to have been conceived in this spirit.

Science and Scholasticism.

Medieval Medicine. By Prof. James J. Walsh. (Medical History Manuals.) Pp. xii+221. (London: A. and C. Black, Ltd., 1920.) Price 7*s.* 6*d.* net.

PROF. WALSH has written an attractive and most readable account of the course of medieval medicine. He has painted a good, even a speaking, picture, but it is not a likeness which most first-hand investigators of his material will easily recognise, nor is the voice with which it speaks that which is familiar to them. As to his learning and competence for his task, no question can be raised, but the method he elects to adopt is one which has brought much work on the history of science into not unjustified contempt. There are authors, less well equipped than Prof. Walsh, who occupy their time in ransacking the printed masses of ancient literature and abstracting passages which seem to show traces of practices similar to, yet quaintly different from, those of our own time. This of itself, though neither history nor science, is an entertaining and harmless antiquarian diversion. But it is a different matter when such extracts, riven from their context, are gravely pieced together and presented as an account of medieval science to a public necessarily ignorant both of the original material and of the method of research. If an expert, such as Prof. Walsh undoubtedly is, adopts this method, he leaves no alternative but protest to a reviewer with first-hand knowledge.

Prof. Walsh's attitude towards the medieval past may perhaps be illustrated by a single critical sentence: "We have come," he says, "to know more about Aristotle in our own time, and as a consequence have learned to appreciate better medieval respect for him." This, we submit, is not an attitude with which many Aristotelian scholars or many men of science will be found in agreement. It is undoubtedly a fact that at the present time the reputation of Aristotle stands very high indeed as an observer of animal life; but that was *not* the cause of his appreciation in the Middle Ages. In the scholastic centuries his reputation in physical science,—we omit discussion of his position in other departments,—was based chiefly on his view of the form of the universe and of the nature of matter and of man. His first-hand and very valuable observations on the habits, structure, and development of animals were either neglected or they were misunderstood and placed in series with his oracular utterances on the circular motions of the heavenly bodies, the sub-celestial character of comets, the existence of the outer æther and of the *primum mobile*, the intelligences of the stars, and the continuous nature of matter. It was these conceptions that earned for Aristotle his position in medieval science, and on the errors involved in them Prof. Walsh is content to be silent.

Prof. Walsh similarly places in the forefront of his argument that "the most interesting feature of the work of the North Italian surgeons of the later Middle Ages is their discovery and development of two specific advances of our modern surgery . . . union by first intention and anæsthesia." Now, since the days of Hippocrates, and doubtless before, the medical attendant, both for his patients' sake and for his own, has never been reluctant to prescribe narcotic drugs to those in acute pain. The medieval physician was accustomed to use far more drugs than are contained in the modern pharmacopœia, and he included in his long list many sedative and narcotic substances. The very vices of the nations will tell of this, for there was never a time when men did not seek oblivion from care and pain in that form of unconsciousness which is brought by poppy and mandragora and all the drowsy perfumes of the East. Such devices were as freely used by medical men in medieval as in pre-medieval or in post-medieval times; in the nineteenth century they were partly superseded by the advent of chloroform and ether, though many surgeons even yet give a dose of belladonna or opium in addition to the inhaled anæsthetic as a routine in major operations. Prof. Walsh, however, seizes on the practice of narcotisation before operation in medieval times, and, directing attention to a few references to the administration of anodyne drugs by *inhalation*,—a generally unsatisfactory procedure with such substances,—he boldly writes:

"Hugh [of Lucca] seems to have been deeply intent on chemical experiments, and especially anodyne and anæsthetic drugs. . . . A great many of these surgeons of the time seem to have experimented with substances that might produce anæsthesia. . . . With anæsthesia combined with antisepsis, it is easy to understand how well equipped the surgeons of this time were for the development of their speciality."

The facts are that Hugh wrote nothing on surgery, or if he did his work is lost; that the evidence, such as it is, of his use of anæsthetics is at best but second-hand; that among all the tens of thousands of medieval medical MSS.—there are some fifteen thousand in this country alone—perhaps some dozen have a single sentence referring to this process of inhalation; that inhalation is a measure ill-adapted to the drugs said to

have been used; and lastly, that the principal author who mentions it—Guy de Chauliac—gives no indication that it was a method that he either approved or had ever employed.

This is the general character of the book. History written on these lines has ceased to be scientific, and, however attractive, learned, or entertaining, cannot be regarded as a serious attempt to interpret the past in the light of present knowledge. CHARLES SINGER.

Ancient Camps in Gloucestershire.

The Ancient Entrenchments and Camps of Gloucestershire. By Edward J. Burrow. Pp. 176. (Cheltenham and London: Ed. J. Burrow and Co., Ltd., n.d.) Price 21*s.* net.

AN observer who casts his eye over one of the most delightful landscapes in England, the view of the Severn Valley as seen from the escarpment of the Cotswolds, with the Malvern range and the Welsh mountains in the far distance, must have noticed the numerous ancient fortifications which stud the Cotswold glacis. Wave after wave of conquest and armed occupation has broken against this hill rampart. Goidel and Celt, British, Roman, Saxon, Dane, and Norman in succession occupied these uplands, and gradually brought the rich valley lands under the plough. The camps remain as evidence of these struggles in the distant past, down to the time when Cromwell drew his entrenchments on Churchdown Hill at the siege of Gloucester.

We have little trustworthy history beyond Neolithic flint implements and similar remains of the builders of these fortifications, until some of them, like Chipping Norton and Landsdown, near Bath, were occupied by the Romans probably before they reached the stage of constructing fortified cities on the model of the camps of their legionaries, like Glevum (Gloucester) or Corinium (Cirencester). When Christianity replaced paganism, some of these camps, like those at Churchdown and Oldbury, became the sites of Christian churches.

The oldest form of camp seems to have been the hill-fortress, generally consisting of a strong bank and ditch, either cutting off a projecting headland from the downs, or marking off an area with an irregular oval line of entrenchments, the two ends resting on the escarpment of the hill. But the more developed types are infinitely varied, often showing considerable strategical skill in the selection of the site, the alignment of the ramparts, and the provision of a water supply. Others, again, were not designed for permanent occupation, being merely temporary shelters for human beings, cattle, and grain in the event of a sudden raid by the Silures or other formidable tribes of the West Country.

Much information regarding these camps was collected by the late Mr. G. B. Witts in his "Archæological Handbook of Gloucestershire," by the local historians, and in the Proceedings of the local societies. Mr. Burrow, though not a trained antiquary, has done useful work in compiling this monograph. After an introduction dealing briefly with the ethnographical and historical aspects of the question, he describes in alphabetical order more than a hundred encampments, and he is careful to give references to the authorities on which his notices have been based. A distinguishing feature of the book is the series of excellent illustrations from sketches by the author of all the encampments described. The format of the book is creditable to the local printers, and the monograph, as a whole, is a good example of careful field work and artistic taste.

Principles of Glass-making.

Glass Manufacture. By Dr. Walter Rosenhain. Second edition, largely re-written. Pp. xv+258. (London: Constable and Co., Ltd., 1919.) Price 12*s.* 6*d.* net.

THIS volume is very welcome, because there are so few English books on glass-making. It brings the author's 1908 edition up to date. It is easy to read and interesting throughout. The preface states that the book is intended for those who are users of glass, and makes no claim to be an adequate guide or help to glass manufacturers; this makes the book rather a disappointment to a glass-maker, who, from the title, would expect more explicit information.

The author invariably keeps to general principles, and does not give any practical particulars, and in some cases just stops when there is no need to do so. For example, on p. 17 he states that results serve to show that chemical composition has a profound influence on the mechanical strength of glass, and on p. 18 that the modulus of elasticity was largely dependent on the chemical composition of the glass—then why not say in general terms in which direction the mechanical strength and the modulus of elasticity vary with the chemical composition? On p. 36 the pure sands are stated to contain 0·2 to 0·3 per cent. of iron; this is evidently an error, and should read 0·02 to 0·03 per cent.

The chapter on "Raw Materials" is instructive, but the author overlooks the fact that dolomite is by far the cheapest form in which to introduce magnesia into common types of glass. The remarks on dimension and height of tank furnace crowns

on p. 76 are very good, but the statement on p. 81 that from four to eight fillings are commonly given to pots is not a fact in practice. The principles of annealing discussed in the latter half of chap. vii. are most useful, and confirm the conclusions arrived at by Mr. F. W. Twyman in his paper read before the Society of Glass Technology at Sheffield in February, 1917.

Bottle glass, rolled or plate glass, sheet glass, and crown glass are well explained in general principles in chaps. ix., x., and xi. Chap. xii., on "Coloured Glasses," is good on the whole, but the author has entirely missed the real function of arsenic and antimony in glass-making. The important question of optical glass is treated in chaps. xiii. and xiv., and the requirements are very lucidly explained, but only old methods are detailed; modern developments in manufacture in this branch of the industry are not even mentioned.

The book is well indexed, and will be read with much interest by both users and makers of glass.

Physical Chemistry.

(1) *Introduction to Physical Chemistry*. By Prof. James Walker. Eighth edition. Pp. xiii+433. (London: Macmillan and Co., Ltd., 1919.) Price 16*s*. net.

(2) *Stereochemistry*. By Prof. Alfred W. Stewart. Second edition. (Text-books of Physical Chemistry.) Pp. xvi+277. (London: Longmans, Green, and Co., 1919.) Price 12*s*. 6*d*. net.

(3) *La Tension de Vapeur des Mélanges de Liquides: L'Azéotropisme*. By Dr. Maurice Lecat. Première partie: *Données expérimentales; Bibliographie*. Pp. xii+319. (Gand: Anct. Ad. Hoste, S.A.; Bruxelles: Henri Lamertin, 1918.) Price 45 francs.

(1) PROF. WALKER'S "Introduction to Physical Chemistry" has, since its first appearance in 1899, been recognised in this country as the standard work for beginners in this branch of science. No great changes from previous editions appear in the present one; the "selected chapter" method of treatment is employed, each branch of the subject being treated from the point of view of showing how physico-chemical principles are applicable to the student's own practical work in inorganic and organic chemistry. Its past success is no doubt due to this and also to the sound and thorough manner in which the explanatory portions are dealt with.

The arrangement of the subject-matter is much the same as in previous editions; two new chapters have, however, been added, one dealing with "Atomic Number," and the other with "Atoms and Electrons." Several of the chapters have been revised, and a number of additions made with the object of bringing the work up to date. Such additions include brief accounts of Ghosh's equation (1918) to account for the abnormality of strong electrolytes and of Dieterici's equation of state, while mention is made of recent work on specific heat at low temperatures and also of the isotopic elements. A useful feature of the book is a list of important references to the appropriate literature at the end of each chapter. This is a book which can be warmly recommended to students of chemistry.

(2) The author states in the preface to the new edition:

"In general I have tried to condense and re-write the material in such a way as to convert what was, perhaps, too much of a reference book into a more readable text-book. At the same time, by the retention of the references given in the previous edition, the volume still maintains its value as a guide to the literature."

"Certain reviewers of the first edition criticised adversely the amount of space devoted to steric hindrance, and in preparing the new edition I have come to the conclusion that they were right, the more so since this subject now attracts less attention than other branches of stereochemistry do. The portion of the volume devoted to steric hindrance has therefore been markedly diminished."

The plan of the first edition has been followed throughout; two new chapters have been added, one being allotted to the Walden inversion, and the other to "The Arrangement of Atoms in Space," a short account of the X-ray work of Profs. W. H. and W. L. Bragg. The book contains three appendices, the first being an interesting account of the relation between physiology and stereochemistry, the second giving directions for making solid models, the employment of which is a great aid to following the subject, and the third containing references to literature on the subject of steric hindrance. The author has succeeded in giving a critical survey of his subject, including recent important work. The book is well got up and illustrated, but contains a few misprints, which, however, are of a minor character.

(3) This book, which was published in Belgium during the German occupation, deals with a very specialised branch of physical chemistry. Azeotropic mixtures are defined as liquid mixtures which, under constant pressure, distil at a constant temperature, their composition corresponding to a maximum or a minimum in the vapour pressure-composition diagram. The work is a

sort of handbook of the subject, and is arranged in three divisions. The first comprises sixty pages, devoted to a theoretical introduction enunciating general laws applying to binary and ternary mixtures. The author gives empirical rules for predicting whether azeotropism will occur in a given binary mixture and for roughly calculating the azeotropic composition and temperature. This portion is concisely written, but rather spoilt by the frequency and length of the footnotes. The second division, which is the largest portion of the book, consists of tables giving experimentally observed data for about 2500 liquid mixtures, mainly binary. As a result of his own experiments, the author points out that azeotropism occurs fairly frequently, some 1000 new binary systems possessing this property having been discovered. In the third division is given a very complete bibliography, and the book concludes with an appendix containing notes on the preparation, in a state of purity, of some of the organic substances employed in the course of the author's researches.

Soils and Manures.

(1) *Soils and Manures in New Zealand.* By L. J. Wild. (New Zealand Practical Handbooks.) Pp. 134. (Auckland, Melbourne, and London: Whitcombe and Tombs, Ltd., 1919.) Price 2*s.* 6*d.*

(2) *A Student's Book on Soils and Manures.* By Dr. E. J. Russell. Second edition, revised and enlarged. (The Cambridge Farm Institute Series.) Pp. xii+240. (Cambridge: At the University Press, 1919.) Price 6*s.* 6*d.* net.

IT is one of the special charms, as it is also one of the special difficulties, of agriculture to the student that it offers such infinite possibilities of variation in its manifestations of the working of the fundamental laws of Nature, not only from country to country, but also from farm to farm, and even often within the confines of the same field.

How desirable it is, therefore, that the cultivator of the soil shall be doubly armed, on one hand with a sound grasp of the basal principles underlying the relationship of crops to soils, and on the other with a knowledge of the characteristic local environmental factors the resultant effect of which determines the level of crop production attainable on the particular area on which his efforts are concentrated! Yet how can the wonderful complex of chemical, physical, and biological relationships involved in the growth of plants in the soil be so simply resolved that he who ploughs may read!

The exposition of scientific principles to the farmer unversed in science, yet engaged in an occupation which represents in its fundamentals perhaps the very acme of complexity in applied science, is a task of the utmost difficulty, and has rarely been accomplished with even moderate success. The common weakness of books of this class, written professedly for the practical farmer, as distinct from the college student, is a failure of the author to keep consistently down to the educational level of his intended reader, to adhere closely to essentials, and to repress the natural inclination to demonstrate his own familiarity with the latest developments of agricultural research, all-important and of absorbing interest to himself, but apt to divert the attention of the reader from the simple essentials which afford him ample material for digestion.

(1) Mr. Wild is fortunate in having in the New Zealand farmer a reader probably on the average better equipped by general education for serious study than the main body of farmers in the home country, and for the particular body of readers to whom he appeals his book is but little open to the foregoing criticisms, so far, at any rate, as the simplicity and clearness of his exposition are concerned. Within the compass of this small book he has condensed a large body of information, much of which will be readily assimilated and found of practical utility by his readers. This applies particularly to his outline of the characteristics and manurial requirements of the various soils of New Zealand. In the exposition of underlying principles to which the first half of the book is devoted, however, we should have ruthlessly eliminated all but the absolute essentials and devoted the space thereby gained to a more leisurely and more fully illustrated discussion of the nature and the mode of action of the latter. Unless we can assume an elementary knowledge of chemistry, physics, and biology in the reader, it is surely better frankly to avoid the attempt at scientific exposition and to concentrate upon implanting firmly in the reader's mind a knowledge of those simple but important conclusions from scientific reasoning and investigation without which he must surely often go astray in his practice.

(2) It is a pleasing indication of the "revival of learning" in British agriculture that a second edition of Dr. Russell's book should have been called for so closely upon its first issue. This work is specifically intended for the young farmer taking a course of instruction of intermediate grade in the type of institution which is now being developed in most counties under the designation of farm institutes. With the teacher's hand to guide him through the more difficult portions, the young

farmer will derive inspiration, together with a useful fund of information, from this book, which is written with the clearness of exposition and forcible reasoning which are so characteristic of all Dr. Russell's writings. The opportunity of a new edition has been taken to embody in the section on fertilisers and manures the new materials and the new points of view which the difficulties of war-time have introduced into British agriculture, whereby the book equips the student with a comprehensive epitome of the resources now at his disposal. C. C.

Our Bookshelf.

Mathematics for Collegiate Students of Agriculture and General Science. By Prof. A. M. Kenyon and Prof. W. V. Lovitt. Revised edition. Pp. vii + 337. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1918.) Price 10*s.* 6*d.* net.

"THIS book is designed as a text in freshman mathematics for students specialising in agriculture, biology, chemistry, and physics in colleges and technical schools" (p. v). Whatever may be the needs of the American student, the book would scarcely be of use in this country. Originality is not expected in a small book designed to be "the entire mathematical equipment of some students" (p. v), but the chapter on statics would surely be much improved if it contained some account of simple machines. The section headed "Mendel's Law" on p. 282 is defective and misleading; witness the following exercises (p. 284): "A farmer buys two different kinds of thoroughbred chickens, but allows them to mix freely. How many different kinds of chickens will he have at the end of (*a*) the first, (*b*) the second, (*c*) the third year of hatching? *Ans.* (*a*) 3, (*b*) 5, (*c*) 9."

R. A. FISHER.

The Elements of Descriptive Astronomy. By E. O. Tancock. Second edition, revised, with additional matter on practical work for beginners with small instruments. Pp. 158. (Oxford: At the Clarendon Press, 1919.) Price 3*s.* net.

MR. TANCOCK is the secretary of the committee appointed by the British Astronomical Association for the purpose of encouraging the teaching of astronomy in schools. This book is based on courses of lessons which he gave to junior forms. A large portion of it is descriptive of the aspect and nature of the various orbs, of which excellent photographs and drawings are reproduced. The remainder is devoted to explaining the celestial motions, which is done in a lucid manner. Instructions are given for making a model of the celestial sphere on the surface of a spherical flask that is half filled with some dark fluid. A useful series of questions and exercises is appended, also a set of passages relating to astronomy, selected from English literature, on which explanation or criticism is invited.

An erratum occurs on p. 55. The time of revolution of Saturn's outer ring should be 13·7 hours, not 137.

Vital Statistics: An Introduction to the Science of Demography. By Prof. George Chandler Whipple. Pp. xii + 517. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1919.) Price 18*s.* 6*d.* net.

THIS manual is intended for American public health officials who, in the author's words, have forgotten most of their arithmetic—not to mention algebra. A good deal of space is consequently devoted to the details of tabulation and the making of diagrams. The census and the statistics of births, marriages, and deaths are fully treated. The absence of uniform laws in the different States of the Union, and the mixed character of the population, are sources of many pitfalls for the student. General rates are of little value in dealing with a population of native-born whites, foreign-born whites, and negroes, and the author duly emphasises the need for care in such cases. The more theoretical parts of the book touch on frequency curves, correlation, and the structure of a life table. In the chapter on correlation, a coefficient 0·54 is described as *low*, and cited as an example of the use of the coefficient as "an admirable weapon for exploding false theories." A public health official would need more technical knowledge than is provided in this book to justify him in rejecting a coefficient of this magnitude.

Insect Life on Sewage Filters. By Dr. W. H. Parkinson and H. D. Bell. Pp. viii + 64. (London: Sanitary Publishing Co., Ltd., 1919.) Price 3*s.* 6*d.* net.

THE title of this little book is rather misleading. The original matter deals almost entirely with one species of insect, *Achorutes viaticus*, in relation to the efficiency of the sewage filters where it is very frequently found in large numbers. The authors seek to prove that Achorutes attack and consume the colloidal matter and fungoid growths which often choke the upper layers of the filters, and in this way enable a larger volume of sewage to be purified than is possible when these insects are not present. Experiments were made with two filters; in one precautions were taken to exclude Achorutes; in the other the insects were encouraged to develop. Analyses of the effluents produced by these filters showed that where Achorutes was absent the purification effected was less than in the other filter, but when the insects were added to the first filter nitrification improved at once. Although the authors' conclusion seems to be justified, their interesting experiment is scarcely worthy of publication in book form. The biological details appear to be mostly from Haig Johnson's work on the subject.

The Transmutation of Bacteria. By Dr. S. Gurney-Dixon. Pp. xviii + 179. (Cambridge: At the University Press, 1919.) Price 10*s.* net.

THIS small book deals with certain variations, morphological and physiological, which are

encountered amongst pathogenic bacteria. The word "transmutation" is employed by the author to indicate the transformation of members of one recognised species into those of another, and he refers in detail to the arbitrary methods hitherto employed by bacteriologists for the differentiation of bacterial species. Apart from two or three pages in which the author's own experimental work is briefly described, the book is mainly a study of bacteriological literature in the English language. A large part of the abundant publications in foreign languages is either not dealt with at all, or is analysed from English abstracts. There is a good deal of reiteration, certain observations, often obsolete, being utilised again and again in different parts of the book. The use of the apostrophe in "Aertryck's bacillus" seems to indicate that the name is that of a man instead of that of a place. The last chapter, entitled "The Enzyme Theory of Disease," deals with the idea that most of the attributes of pathogenic bacteria can be referred to the activities of ultramicroscopic bodies of the nature of enzymes, and the author considers that this may be the means by which bacteria may exchange many of their characters and functions without themselves undergoing transformation.

The Examination of Materials by X-rays. A General Discussion held by the Faraday Society and the Röntgen Society, Tuesday, April 29, 1919. Pp. 88+64. (Reprinted from the Transactions of the Faraday Society, vol. xv., part 2, 1919.) (London: Faraday Society, 1919.) Price 13*s.* 6*d.*

THE Faraday and Röntgen Societies did good work when they held a joint meeting in April last year and thrashed out the position as regards the achievements, possibilities, and limitations of the method of the examination of materials by X-rays. The present volume will form a most useful jumping-off point for the investigator or manufacturer who desires to know what had been achieved in industrial radiology up to 1919. The contributors to this "symposium number" include many of the leading radiographers in this country who have not confined their interests to medical radiology. Not all the noteworthy work achieved during and since the war was, however, available for publication when the discussion was held.

The first paper, by Prof. W. H. Bragg, forms a delightful introduction to the subsequent papers and discussions, which deal with such varied subjects as steel, light alloys, aircraft timber, carbon electrodes, X-ray plates, etc. There are many excellent reproductions of radiographs.

One realises, from a close reading of the volume, that we stand only on the threshold of radiology, and big and unexpected developments are probable during the next ten years. Both the Röntgen and Faraday Societies are to be congratulated on the results of the meeting. We understand the volume is procurable from the secretary of either society.

Commercial Oils: Vegetable and Animal. With Special Reference to Oriental Oils. By I. F. Laucks. Pp. viii+138. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1919.) Price 6*s.* net.

THIS is a handy little book, intended, not for the oil chemist, but for those persons concerned in the oil industry who have no knowledge of chemistry, or at least no knowledge of it as applied to oils. There are no doubt many such who will often desire to understand what is meant by the various analytical tests and terms used in the specifications on which large users of oil base their contracts of purchase. For example, on p. 70 of the book there is a specification for oil to be employed as a lubricant for aircraft engines; this stipulates that the oil must have (*inter alia*) a certain iodine number, saponification value, flash point, and so on. The author describes in simple terms what these and similar phrases mean, and how they are employed as criteria of the purity and quality of the oil. He gives also short descriptions of the principal oils and fats met with in commerce, and has some very useful advice to offer on methods of taking samples. Even the expert may peruse this part of the volume with advantage, and the non-technical reader should at least have an intelligent idea of the whole subject after studying Mr. Laucks's book.

The Birds of the British Isles and their Eggs. By T. A. Coward. First series. Comprising Families Corvidæ to Sulidæ. Pp. vii+376+159 plates. (London and New York: Frederick Warne and Co., Ltd., 1919.) Price 12*s.* 6*d.* net.

THIS volume of "The Wayside and Woodland Series" of handy pocket-guides affords a popular account of our British birds. Such a work, especially if embellished with good coloured plates of the various species and their eggs, and accompanied by trustworthy letterpress, has long been a desideratum. The figures of the birds are reproductions, much reduced in size, of those in the late Lord Lilford's much-prized book. They are 159 in number, and most of them are decidedly good; but others are disappointing from the fact that the three-colour process has not been equal to doing them justice. The figures of the eggs, which are from one of the editions of Hewitson's well-known book, are disappointing for the same reason, and will mislead the tyro who attempts by their aid to name many of his specimens. There is also an acceptable series of black-and-white illustrations devoted to nests, etc.

Mr. Coward's letterpress, as one would expect, is good, but it is questionable if his excellent descriptions of habits have not been awarded too much space at the expense of other sections, among them the British distribution of the more or less local species. Given a knowledge of the bird and where it is likely to be found, its various activities may be observed by those who care to devote their attention to the delights of bird-watching. This neat and useful little volume—the first of the series on birds—will, no doubt, be

much appreciated by those who desire a popular book at a moderate price.

Practical Exercises on the Weather and Climate of the British Isles and North-west Europe. By W. F. Stacey. Pp. vii+64. (Cambridge: At the University Press, 1919.) Price 2*s.* 6*d.* net.

MR. STACEY has produced an excellently planned little book, a model of the way in which a specific inquiry into a subject of relatively narrow compass should be conducted. But, although the methods he adopts are suitable for school work, the subject-matter under consideration is not geography, and is not necessary for all or perhaps for any of the forms of a secondary school. Mr. Stacey has selected a typical set of weather data for the British Isles from the Daily Weather Reports, and has based thereon exercises in which the pupils construct and interpret weather maps. Naturally enough, the work is based upon the records of pressure observations, and his titles include the terms "cyclone," "depression," "wedge," "col," and "anticyclone." The exercises deal with weather records, but not with climate. It is fairly certain that the study of pressure, as distinct from the study of isobars, is out of place in a school geography course unless carefully correlated with a well-developed course in physics, and it is to be feared that Mr. Stacey's efforts will lead to a juggling with words and symbols rather than to a comprehension of atmospheric conditions.

Alternating Current Work. An Outline for Students of Wireless Telegraphy. By A. Shore. Pp. ix+163. (London: Wireless Press, Ltd., 1919.) Price 3*s.* 6*d.* net.

As shown by the sub-title, this work is addressed to students of wireless telegraphy. It outlines, without very elaborate mathematics, the general principles of alternating currents and their generation, transformation, etc., in a way readily intelligible to those having already some general knowledge of electricity and magnetism. As the book advances, the treatment specialises more and more in the direction of wireless working. Discussions of the influence of inductance and capacity lead up to a consideration of resonance, and high-frequency resistance is given a prominence justified by its importance in this class of work. A few typical measuring instruments, as used in wireless installations, are briefly described at the end. A reviewer, on turning over the leaves for the first time, might receive a false impression from the presence of an illustration in the chapter on alternating-current generators of an obsolete, although historically interesting, type of machine. This is, however, not unduly enlarged upon in the letterpress. The book is clearly written throughout, and should save those for whom it is intended much trouble and waste of time in picking out the parts of the subject that they require from the many more complete and general works on alternating-current working.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Science and the New Army.

THE leading article on "Science and the New Army" in NATURE of March 18 raises a number of points of fundamental importance with regard to the future relations between science and the Services. The whole subject may conveniently be considered under two heads: (*a*) The utilisation of the results of scientific research for military purposes; and (*b*) the direct employment in times of emergency of scientific workers themselves.

With regard to the first, the difficulty has been the lack of real contact. The university worker is necessarily largely withdrawn from the problems of everyday life; and this, not through either mental incapacity or unwillingness on his part, as many people seem to think, but mainly because his time is usually fully occupied with teaching or university routine. Thus he is not, in many cases, even aware of the problems which need solution, and some organisation is required to bring them to him. More, however, than this is wanted if he is to give active help, and attention will have to be carefully given to the following points:—

(1) There is a great disinclination among reputable scientific societies to publish work (even though it may be of considerable practical value) which does not constitute a definite advance in science itself. Now, the solutions of many Service problems are, from the scientific point of view, trivial, though laborious. Nevertheless, it is of great importance that they should be *explicitly* worked out and reach the people interested. On the other hand, technical journals often look askance at what they would probably call "academic" contributions. There is here a gap to be bridged.

(2) Even a scientific worker will expect either remuneration or credit for his work; if the Services expect his collaboration, they must be prepared to pay for it. It has frequently happened that scientific men have given their time and efforts without stint and received little beyond mere thanks (if as much), whilst the credit has been monopolised by some administrative official.

(3) It must also be made clear that scientific workers are not wealthy amateurs, and that the sum (sometimes considerable) necessary to finance preliminary experiments must be provided. Further, the Services must be willing to take the worker into their confidence and to let him observe for himself the actual conditions to which his work will apply. Most Service men cannot even state a problem to a researcher, and are incapable of distinguishing between data which are essential and those which are not. It is entirely useless to expect a scientific man to work in the dark, on second-hand statements from them. For example, one cannot work on submarine detection without submarines at one's disposal. Facilities (which may involve the temporary use of a ship, of aircraft, or of troops) are necessary if results are to be obtained.

In this connection I feel doubtful as to the wisdom of the policy quoted in your leading article from the memorandum of the Secretary of State for War of separating what is called "pure research" (query: Does this mean "research in pure science"?) from

"applied research," which latter it is proposed to restrict to military institutions. This seems an unfortunate distinction. If a research is initiated in view of a definite application, then that application must never be lost sight of, and the whole should be co-ordinated by the same brains, or else the "pure" and the "applied" researchers will be at cross-purposes. The co-ordination should be done by the research worker himself, not by semi-scientific officials appointed for the purpose.

(4) The creation and development of firms willing to carry out experimental work ought to be encouraged and subsidised. Even during the war, and with the backing of a Government Department, it was often a matter of the very greatest difficulty to get firms not to neglect experimental work in favour of mass production.

(5) It would be well if officials would understand that a scientific man does not work in the same way or under the same conditions as, say, an orderly officer or a clerk, and that he should be given the utmost freedom of movement and of hours; that he should not be continually bothered with reports and returns or unnecessary official correspondence; and that usually he does his real work, not in an office, but in the solitude of his study, and sometimes during wakeful hours in the night. They will also have to realise that research work is individual, and that one cannot hand it over from one person to another every six months, as one does a platoon.

(6) Finally, the Services must be prepared to put up with negative results without making a wry face or putting a black mark against the worker. The trail of science is dotted with the bones of dead theories and the remains of unsuccessful attempts, yet it is largely by means of these that science has been built up.

Coming now to the other side of the question, namely, the employment of scientific workers in the Services in an emergency, this is a problem needing urgent and careful attention. Undoubtedly the treatment of it during the war left much to be desired. The only co-operation which the War Office apparently looked for from the universities, previous to the outbreak of war, was that, through the Officers Training Corps, they should provide a proportion of Reserve officers—chiefly infantry—with a minimum of military training of the normal pre-war type. The idea of using the specialised knowledge of the universities for the technical services of the Navy, Army, and Air Force took shape only very slowly, as the development of the actual fighting made it plain that science would play an increasing, perhaps eventually a predominant, part in modern warfare. By that time much of the promising human material which the universities might have supplied had already been wasted. The main difficulty, however, which was then encountered (and still exists) was that the regular military or naval officer upon whom devolved the choice of persons for appointments of a quasi-scientific nature had not, in general, a suitable education or training for estimating scientific ability. The inevitable result was that large numbers of young men with little or no qualifications got taken on in a hurry at their own valuation, while the best use was not made of such real experts as were available.

I feel that the writer of the article in NATURE has hit the right nail on the head when he says: "Until it is made obligatory for a proportion of them [the General Staff] to have had such a training [in science], the fundamental reform will not have been effected." The same, of course, applies even more strongly to the Air Force and the Navy. In the latter the scientific tradition is much more powerful, and there, on the whole, far better and more intelligent co-operation was obtained. I would suggest, however, that what is most urgently needed for General Staff officers is a course of scientific classification and organisation where they would be taught the real meaning of scientific qualifications and the names of living authorities in various subjects. This would enable the military administrator at least to make an intelligent selection.

I also agree that "it is surely most desirable that, for the future, science should have some scheme of mobilisation ready." What is wanted is a mobilisation register of all scientific workers, carried out under the auspices of a committee on which the various scientific bodies and the universities should be represented. This mobilisation register would indicate, from the scientific side, the age, qualifications, and grade of the worker, the nature of the work which may be expected from him, and the remuneration which he is entitled to expect. The Service authorities could then add medical category, arm or branch of Service to which assigned, rank (if it be desired to give a commission), unit, and place of mobilisation.

So far I have dealt purely with the technical side of the Services; but brains are not unnecessary on the executive side, and the suggested register might well be extended to cover men with high intellectual (not necessarily scientific) qualifications who happened also to have had an adequate amount of military training, so that on the outbreak of war they might be ear-marked for Staff appointments. In 1914 we had a highly trained, if small, General Staff; unfortunately, most of them (to their own great honour, but the nation's loss) rushed to the front line, and a large proportion never returned. Their places and the new vacancies created by the expansion of the Army were necessarily filled in an unsystematic way, as emergency dictated. Many of the junior Staff appointments had to be given to men who had had an inadequate general education and no pre-war military training.

The War Office might well consider the possibility of instituting a General Staff Reserve, largely drawn from among university men. The officers of this Reserve should (by expanding the Officers Training Corps organisation or otherwise) be kept in constant touch with the growth of military thought and practice; they might be called up at fairly frequent intervals for courses, or attachments to Regular units, or manœuvres on a large scale, and they should be adequately remunerated for the time they gave.

L. N. G. FILON.
University of London, University College,
March 20.

I HAVE read the leading article on "Science and the New Army" in NATURE of March 18 with great interest but with mixed feelings. The meaning of the word "research" and the value of the investigator who researches have, in my opinion, never been fully appreciated by the official or military mind.

The attitude of repression and discouragement so general at the beginning of the war was particularly depressing for those of us actually in one of the Services, and therefore not free agents. Towards the end, however, there certainly was a distinct and gratifying change of front—a change which, at any rate in the section I knew best, produced excellent results. Yet, with the best intentions in the world, the authorities in their experimental establishments must needs call into existence a bewildering and unnecessary maze of organisation, or rather over-organisation, in which ten men did badly the work of one, and the few true investigators and designers, for whom presumably all this had been arranged, found

themselves so tied and hobbled as to be practically helpless.

It does not seem feasible, in fact, usefully to organise research on such lines. Research—and design, for that matter—speaking again of the little corner I knew, has been almost invariably the result of the strenuous effort of individuals, and not the fruit of the organisation in which these particular individuals happen to have been embedded at the time. It is not meant to imply that there should be no organisation in Government experimental establishments, but, speaking from experience, I feel most strongly that capable investigators and designers will not produce their best if compelled to work in an atmosphere of over-organisation.

What must surely be a matter for congratulation to the body of scientific workers in the country is the fact, which the article referred to brings out, that the Army (and presumably also the Navy and the Air Force) has learnt its lesson, and hastens to admit that there is something to be gained even in peace from the universities and other scientific and technical institutions. Yet here again one seems to detect—perhaps in pessimism—a touch of misunderstanding. The Government's policy (expressed in the following rather unfortunate words) is "to farm out to civil scientific institutions, such as the universities, the National Physical Laboratory, the Imperial College of Science, etc., all pure research that can be profitably farmed out." The universities will surely be only too willing to give the most sympathetic consideration to a co-operative scheme of this sort, provided that the subject-matter of the researches to be "farmed out" is sufficiently interesting and important.

Presumably the Department of Scientific and Industrial Research will be largely responsible for the allocation of these researches, but if at the same time the smallest step is taken towards "the detection of overlap [in research], where such exists, and its elimination," a feeling the reverse of sympathetic will be set up.

Investigations worthy of the name should surely be carried out in all freedom of both thought and action; even the suspicion of interference would be intolerable. The official interest now taken by the Army in scientific research is a great sign of regeneration—if, indeed, it is more than a surface interest, as we all hope. Let us pray that over-organisation of the Government experimental establishments and unsympathetic treatment of civil scientific institutions will not dwarf the growth of the new scheme.

R. WHIDDINGTON.

The University, Leeds, March 23.

THE leading article in NATURE of March 18 directs timely attention to the need for action by men of science if the lessons of the war are not to be forgotten in the Army of the future.

It was impossible in the war to scrap the old machine; years and experience are essential if a better new one is to be made. But no memorandum or paper policy, or even consultation with experts, will make a good machine unless the right material is used.

In peace-time the new Army should have technical education (in the broad sense) and scientific research as its two main functions: they are the only sound bases upon which an efficient fighting machine can be built. That appears to be accepted. But these functions can only be performed by an Army with an educated staff, led by scientific men who combine originality with administrative capacity. If the main body of the staff consists of men without the rudiments of a scientific education, who will "administer" the men of science and control the allocation of funds, then there will be a largely unnecessary sacrifice of the Army if a great emergency arises.

With regard to the co-ordination of research, it is true that a good deal of duplication must inevitably occur if the independence essential for great discoveries is to be maintained. But there is much unnecessary waste which can be avoided without real restriction of independence. The direct economy is, however, of minor importance; the greatest advantage comes from forming the habit of consulting the right department or the right expert; and this is as necessary for the man of science as for any other man. The late Lt.-Col. W. Watson, whose untimely death deprived the nation of an expert with an almost unrivalled knowledge of the applications of science in war, once related how a board of chemists spent half a day discussing a meteorological problem which could have been solved in half an hour by a single meteorological expert.

E. GOLD.

March 22.

ALL scientific workers whose research has brought them into contact with military authority during the war must appreciate the leading article on "Science and the New Army" in NATURE of March 18, especially the sentences in which it is urged that "science linked to the Army by fussy research co-ordinators acting under a nescient soldier will not solve the difficulty," and that "science will not occupy its rightful position in the new Army" until the General Staff includes a due proportion of officers who are endowed with a scientific spirit and have received a scientific training. Until then some of the outstanding defects manifested during the war will continue. These defects are:—

(1) *The unthinking application of scientific research.* A good instance of this occurred in the issue of the ridiculously excessive diet (based on research under active marching conditions) to our soldiers in Flanders who were unexercised in the trenches, whilst wholly inadequate rations were being supplied during the period of the soldiers' strenuous training in England.

(2) *The delay in seeking expert advice.* Too often G.H.Q. failed to realise how expert advice could help it, and did not trouble to seek it until too late.

(3) *The choice of expert.* The truly scientific worker rarely asserted himself spontaneously during the war; he waited until his advice was asked. The man who forced himself to the notice of the General Staff as an expert was usually unscientific. Thus G.H.Q. was "taken in," and came to rely too often on those whom the scientific world considered as being pretentious in greater or less degree. Their one source of strength was that they were usually "practical" men, whereas the men of science in some cases offered suggestions which could scarcely be carried out during service in the field. But in the long run the Army suffered.

CHARLES S. MYERS.

30 Montagu Square, W.1, March 29.

Knowledge and Power.

THE leading article "Knowledge and Power" in NATURE of March 25 strikes a resonant chord. I am a newcomer into the realms of officialdom, but my experience relates to a Department of State which is of new growth and not yet rooted in tradition. Aeronautics in Britain has had its foundations laid on a scientific basis, and technical staffs have been able to build on trustworthy data. In view of the fact that British aircraft obtained an absolute ascendancy over the craft of any other country, Allied or enemy, and that Britain was the only country with this scientific

foundation, it is not unfair to regard the two facts as being, in some measure, cause and effect.

The scheme which led to the scientific basis was announced in 1909 by the then Prime Minister, and was the result of advice from scientific and technical men, of whom it is sufficient to mention the late Lord Rayleigh as leader. Throughout the vicissitudes of air developments—separate naval and military Forces, Air Board, and Air Ministry—the Advisory Committee for Aeronautics maintained a steady course and steady output of fundamental data. It was, unfortunately, not responsible for the conduct of full-scale research at the Royal Aircraft Factory, and the lack of any definite policy on the part of those in control has led to the reduction of the full-scale experimental side to relative insignificance.

During the war large developments in aviation were called for, and scientific and technical men devoted their efforts to make the best of a very difficult situation. The Technical Department was not attached in an advisory capacity to the Royal Air Force, but was subordinated to the Department of Aircraft Production. As a consequence of this it would appear that the responsible advisers of the Secretary of State too frequently found themselves in the position of children crying for the moon. The effect during the war was minimised by the absence of rigid organisation, and has been fundamentally modified by the recent absorption of the Department of Supply and Research by the Air Ministry, whereby the technical side is directly represented on the Air Council. It can now be pointed out at their inception that certain policies are technically unsound.

The result of relegating the Technical Department to a position of inferiority during the war has been little short of a disaster. Within a few weeks of the armistice both the Controller and Deputy Controller had left; they were followed by the three Assistant Controllers and the great majority of the senior members of the staff. It is true that many had only entered aeronautics in view of the war emergency, but the rapidity with which the offices became vacant was, I think, an indication that the atmosphere was one in which scientific and technical ability could not exist.

The process of attrition is not ended, and the best British business firms are attracting the picked men. Aeronautics, from the business point of view, has been a testing-ground of a man's capacity and adaptability, and as the science and practice of the subject are still young it appears to be better for the individual to abandon his special knowledge and to return to general engineering rather than to remain in a profession which has no openings or prospects for those in it. It is no exaggeration to say that the policy adopted by the State towards scientific and technical knowledge in aeronautics has brought this side of the profession to a condition in which its continued existence is doubtful.

The man of science and the technician, particularly the former, is in large measure himself responsible for this state of affairs. He has been content to recognise the importance of the work he has been doing as justification for acceptance, in spite of a non-commercial salary. The conditions now prevailing have brought home to him the fact that he cannot maintain himself in a reasonable standard of life on this basis. In an age when the value of a man's work is estimated in terms of the money he earns, it is not wise to neglect the criterion applied, although all should help in the search for the sounder basis towards which the industrial world is groping its way. As a scientific man I regret that we are not taking the lead, but are considerable laggards in the search for a just method of payment by results.

March 28. L. BAIRSTOW.

Museums and the State.

IN the recent correspondence on this subject the opinion has been expressed that a lack of co-operation between the various national museums has diminished their efficiency. In this connection it may be useful to recall the report of a Committee upon the Science Museum and the Museum of Geology in Jermyn Street of which the first part was issued in 1911 and the second in 1912; the former was discussed in NATURE at the time (May 4, 1911). This Committee, on which science was strongly represented, was appointed by the President of the Board of Education, and consisted of Sir Hugh Bell, Sir James Dobbie, Sir Archibald Geikie, Sir Richard Glazebrook, Mr. Andrew Laing, the Hon. Sir Schomberg McDonnell, Sir William Ramsay, Prof. W. Ripper, and Sir W. H. White. They were asked to advise as to the educational and other purposes which the collections could best serve in the national interests, the lines on which the collections should be arranged and developed, and as to the new buildings to be erected in order to house and exhibit them suitably.

The report therefore deals with the work and functions of the museums, and does not discuss the form of control most suitable for their administration. Here the Committee makes definite recommendations on many sections of the collections, and wherever these connect with other national institutions it insists upon the importance of co-operation, besides commenting upon any cases where overlapping may possibly occur. Thus there already exists a definite scheme governing the relation of these museums to the Natural History Museum, the Museum at Kew, the Imperial Institute, and the map collection of the Royal Geographical Society; and, but for the war, its results would doubtless by now have been apparent.

In concluding its report the Committee notes with satisfaction the arrangement for providing accommodation for the Museum of Practical Geology at South Kensington contiguous to the Natural History Museum and the Science Museum as contributing materially to that co-operation which it had recommended.

The whole report well repays careful study by all interested in museum organisation. F.R.S.

The Magnetic Storm of March 22–23 and Associated Phenomena.

A VIOLENT magnetic storm occurred on March 22–23. It had an S.C. ("sudden commencement") about 9h. 10m. on March 22. This was not outstanding, except that the initial increase in H was immediately followed by a reverse movement, bringing the element below its normal value for the next two hours. The normal value was sensibly exceeded from 12½h. to 14h., and again most of the time from 16½h. to 19h. The maximum occurred just after 17h. In the course of twenty-five minutes, from about 16h. 50m. to 17h. 15m., H rose 280γ and fell 360γ. The trace was off the sheet on the negative side for about six minutes near 1h., eight minutes near 1h. 30m., and thirteen minutes shortly after 4h. It was rising rapidly after each reappearance, so that the range shown on the trace, 810γ, was probably considerably exceeded. The largest movements were from 16½h. to 19h. on March 22, and from 0h. to 6h. on March 23. There was a comparatively quiet interlude from 19½h. to 23h. on March 22. The times of greatest disturbance in declination synchronised fairly with those in H. The extreme westerly position was recorded about 17h. 8m. on March 22, and the extreme easterly position near 1h. 40m. on March 23, when the trace was off the sheet for twelve minutes. There were several exceptionally large rapid move-

ments. In the course of about five minutes from 17h. 8m. to 17h. 13m. there was a swing of 1° 35′ to the east, immediately following a somewhat less rapid swing of 44′ to the west. In the course of about twelve minutes from 1h. 9m. to 1h. 21m. on March 23 there were swings of 76′ to west and 59′ to east, and after a minute's pause the latter swing continued, so that declination at 1h. 28m., when the trace went off the sheet, was 1° 35′ less westerly than it had been nine minutes before. The range actually shown on the sheet, 2° 1′, has seldom been equalled at Kew, and as the trace was off the sheet for twelve minutes it was probably sensibly exceeded.

The vertical force trace was complete, the range of disturbance being about 820γ. The disturbance in that element was fairly normal, the value being enhanced on the afternoon of March 22 from 13h. to 23h., and correspondingly depressed on the morning of March 23 from oh. 30m. to 7h. The times of maximum and minimum were respectively about 18h. 20m. on March 22 and 4h. 10m. on March 23.

The outstanding features of the disturbance were the size and rapidity of the largest movements, and the separation of two very highly disturbed periods by a comparatively quiet interlude lasting several hours. The disturbance was preceded twenty-seven days before (February 24) by a considerable, but much smaller, disturbance, which was in some respects the antithesis of the later one. It lasted only about ten hours, and the largest movements occurred in the course of the first three hours. C. CHREE.

Kew Observatory.

THIS storm was one of exceptional violence. It commenced suddenly at 9h. 6m. G.M.T. on March 22. The H.F. magnet experienced a sharp positive movement of 37γ, followed immediately by a decrease in force of 41γ ($1\gamma \triangleq 10^{-5}$ C.G.S. unit). Similarly, the D. magnet swung sharply to the west and then to the east, the range being 8′ of arc.

After three oscillations on the negative side of the normal, a steady rise of value commenced in the H.F. magnet at 10h. 36m., which lasted until 19h. 10m., when the spot of light began to fall steadily towards the normal value of the force. The general character of the movement was that of one long wave with oscillations superposed upon it, the storm being most violent between 16h. and 19h. 10m. During this period the spot of light passed beyond the limits of registration in a series of rapid oscillations between 16h. 24m. and 16h. 30m., 16h. 46m. and 17h. 12m., 17h. 54m. and 18h. 14m., 18h. 41m. and 18h. 47m., and 18h. 47m. and 18h. 51m. The oscillations became less violent and rapid after 19h. 37m. At 23h. 5m. the spot of light had fallen to a value close to that of the base line, so that the extreme range in this sweep of the curve was from a value greater than 550γ to 52γ.

At 23h. 16m. a rapid oscillatory recovery and increase of value took place, which attained a maximum of 376γ at 23h. 36m. The spot of light then went off the recording drum on the negative edge, crossing the base line on March 23 at oh. 24m. During the next four hours it was several times beyond the limits of registration on the negative side in a series of rapid oscillations, in which the greatest range exceeded 260γ.

The extreme range in H.F. during the storm was greater than 700γ. This value may be compared with the range on the quiet days during January and February, which had a mean value of 18γ.

At 4h. 20m. the spot of light returned to a positive value, when a series of very rapid shiverings of the needle took place, similar to those which terminated the violent magnetic storm of August 11–12, 1919. These oscillations had a range of about 130γ, and lasted until 8h. 50m. This may be regarded as the end of the violent storm, though the needle continued to be disturbed moderately until midnight of March 25.

The general character of a sinuous S-like curve is well shown on the trace from the vertical force magnet. It crossed the base line at oh. 44m. on March 23. There was a very rapid oscillation of the needle at 1h. 0m. The spot of light remained below the base line until 6h. 0m., when it gradually rose, with a shivering movement of small amplitude, to its normal value. On the negative side the spot of light was off the recording drum from 1h. 20m. to 2h. 40m. and from 2h. 40m. to 4h. 0m. The extreme range was greater than 900γ, and the greatest positive value was 642γ.

Corresponding to the gradual increase in force in the H.F. and V.F. elements, the declination magnet gradually swung to the west. The maximum disturbance consisted of some rapid swings of the needle between 16h. 24m. and 18h. 48m. The greatest of these was at 17h. 0m., the range being 90′ of arc.

A very remarkable rapid double swing of the needle occurred on March 23 at 1h. 12m. The range of this oscillation was 130′. This corresponds to rapid oscillations in the force elements. The spot of light was now, on the whole, below the base line until 4h. 0m., when there was a rapid movement east and then west between 4h. 15m. and 5h. 0m., with a range of 120′. A series of shivering oscillatory movements then supervened until the end of the storm. The greatest total range in D. during the storm was 160′.

Judging from the three elements, the general movements both in force and in direction were rising with reference to the base line during the daylight hours and falling during the night hours.

The storm was coincident with the appearance of a very great sun-spot group on the sun's disc which appeared between March 16 and 29, and was passing the central meridian on March 22–23. Its mean heliographic latitude was −6°, and it extended from longitude 114° to longitude 150°. It was the biggest group of sun-spots observed since August, 1917, and its disc area, in units 1/5000th of the visible disc, was 34 on March 22.

It was a revival of a similar extended group of spots of large area observed from January 21 to February 3. At the next rotation, February 17–27, this group appeared as an insignificant small spot and dots amidst extensive faculæ. But the magnetic elements began to be disturbed during this second rotation of the spot-group on February 16–17.

Through the kindness of Lt.-Col. Penny, R.A.M.C., the O.C. Queen Mary's Military Hospital, Whalley, in the immediate neighbourhood of Stonyhurst College, I have received the following account of the aurora borealis observed by him in the early morning of March 23:—

"On going out of doors at about 3.15 a.m. I noticed this display, but I do not know how long it had been visible. It was a clear, starlight night at the time. The aurora was exceedingly fine when I first saw it, the best I have ever seen. It consisted of about eight broad beams of light, most of which, except the extreme west and north ones, extended to within 5°–10° of the zenith. The lights extended over about 90°–100° from approximately north-north-east to west by north.

"The beams became pale and brilliant again several times, besides constant slighter variations in intensity. On two or three occasions, within about twenty minutes, most of the beams, more than three-quarters,

disappeared, leaving one or two longish ones. The colour was mostly white, but sometimes reddish in parts, especially nearly due north.

"A curious feature was an oblique band of light, which came and went across near the summits of the vertical beams. I do not think this was a belt of illuminated cirrus, as its brightness seemed to vary independently of the vertical beams, but it is possible it may have been. The lights had diminished considerably by about 3.45 a.m., but had brightened again, though slightly, when I looked out a few minutes later. I do not know what time the display ended." A. L. CORTIE.

Stonyhurst College Observatory, March 29.

Some Methods of Approximate Integration and of Computing Areas.

THE formulæ which Mr. Percival gives in NATURE for March 18 for approximate integration are well known, but there are one or two points in connection with them which are frequently overlooked, especially by writers of books on mathematics for engineers.

(1) The areas bounded by curves the equations of which are of the form

$$y=a+bx+cx^2+\ldots+kx^n$$

can be obtained from the values of $2m+1$ equidistant ordinates, not only when $n=2m$, but also when $n=2m+1$. That this is so is seen most easily by taking the origin at the centre of the range of integration and noting that

$$\int_{-h}^{+h} x^{2m+1}dx=0.$$

For example, Simpson's first, or three-ordinate, rule gives the area of the cubic

$$y=a+bx+cx^2+dx^3$$

with perfect accuracy, and for this purpose his second, or four-ordinate, rule is in no way superior.

(2) By a very small change in one of the coefficients Weddle threw the seven-ordinate formula (No. 6 in Mr. Percival's letter) into the very convenient form

$$A=\frac{3h}{10}\left[y_1+y_3+y_5+y_7+5(y_2+y_6)+6y_4\right].$$

The loss of accuracy which the change involves is exceedingly small.

(3) Formulæ based upon the assumption that the boundary curve can be represented by an equation of the form above stated give unsatisfactory results when the actual boundary has tangents at right angles to the x-axis. This is really the reason why none of the results obtained by Mr. Percival in applying his formulæ to the quadrature of a circle possess a higher degree of accuracy than that represented by the admission of errors of the order of 1 per cent.

If we suppose the curve to cut the axis of x at right angles at the origin, it is better to assume that it can be represented by $y=ax^{\frac{1}{2}}+bx$ in the neighbourhood of that point.

If y_1, y_2 be the ordinates at $x=h$, $x=2h$, the area bounded by the curve, the axis of x and the ordinate y_2 is given by

$$A=\frac{4h}{15}\left[4\sqrt{2y_1}+y_2\right].$$

The much higher degree of accuracy resulting from the employment of this formula may be illustrated by applying it to Mr. Percival's example of the quadrant of a circle.

The seven ordinates are:—

$y_0=0$	$y_4=0.9428090$
$y_1=0.5527708$	$y_5=0.9860133$
$y_2=0.7453560$	$y_6=1$
$y_3=0.8660254$	

Using the above formula to find the area between the ordinates y_0 and y_2, and Simpson's first formula for the part between y_2 and y_6, we obtain the value 0.7853871. The true value is 0.7853982; hence the percentage error is only 0.0014, which compares very favourably with the errors ranging from 0.8 to 1.34 per cent. obtained by using the usual formulæ for the whole range.

Mr. Percival's example clearly shows that when the curve has a tangent at right angles to the axis, no material reduction in error is attained by using formulæ with a larger number of ordinates. The use of Simpson's formula over ordinary ranges and of the formula given above in the neighbourhood of such tangents will prove much less laborious and far more accurate. J. B. DALE.

King's College, Strand, March 22.

IN NATURE of March 18 Mr. A. S. Percival gives an example (the quadrant of a circle) in which Simpson's rule (sometimes called his first rule) is more accurate than the "three-eighths" rule, and he remarks: "This result is curious, and shows that a small arc of a circle approaches more nearly to a small arc of a parabola than to a small arc of any cubic curve." Permit me to point out that this inference is not valid, and is based on the almost universal illusion that Simpson's rule is correct to the second order only, *i.e.* for the parabola

$$y=a+bx+cx^2.$$

It is easy to show by simple integration that Simpson's rule holds to the *third* order, *i.e.* for *all* cubics of the form

$$y=a+bx+cx^2+dx^3,$$

passing through the three chosen points. It is thus precisely accurate, not only for the parabola, but also for a singly *infinite* number of curves passing through the three points, even if an inflexion occurs.

One would therefore expect (which I believe to be the case) that where both rules can be applied (*e.g.* if there are seven ordinates) Simpson's rule would be more accurate than the "three-eighths" rule, which is precisely true only for a single curve passing through four consecutive points.

In some cases, when the gradient is not rapid, Simpson's rule is highly accurate. Dr. Lamb ("Infinitesimal Calculus," p. 278) gives an example in the evalution of π to six decimal places from the equation

$$\int_0^1 \frac{dx}{1+x^2}=\frac{\pi}{4}$$

by taking ten equidistant values for x, but he does not notice the illusion to which I refer. I am surprised that such a simple and easily tested truth should so long have escaped the notice of many expert mathematicians. R. A. P. ROGERS.

Trinity College, Dublin, March 20.

Gravitational Deflection of High-speed Particles.

THE result mentioned by Mr. Leigh Page and verified by Prof. Eddington (NATURE, March 11, p. 37), that the gravitational effect on a particle travelling radially is a repulsion if the speed exceeds $1/\sqrt{3}$ times the light-velocity, is given by Hilbert in the *Göttinger Nachrichten* for 1917. The same paper contains interesting remarks on the path of a particle or light-pulse moving spirally round the gravitation centre.

Hymers College, Hull. H. G. FORDER.

Colouring Matters of Plants.

IN view of the fact that many of Nature's most striking colour effects are produced as the result of harmonious groupings of highly coloured plant life, and that it is to the various plant pigments that these fine tints owe their origin, it is not surprising that chemists have striven, from quite early days of the science, to elucidate the chemical structure of these colouring matters, and botanists to discover their relationship to the vital activities of plant life.

During recent years our knowledge concerning plant pigments has been rapidly and greatly enlarged, and observations have been made that are of great significance to chemist and botanist alike, whilst the horticultural possibilities which they seem to indicate should be of interest to even the most casual lover of Nature's beauties.

When referring to plant colouring matters it must be borne in mind that it is necessary to distinguish between the plastid pigments (chlorophyll, carotin, etc.) and the water-soluble sap-pigments. The present article will deal only with the latter group—sap-pigments—but it must not be imagined that this indicates that progress has not been made in the researches upon plastic pigments; indeed, much knowledge concerning them has resulted from the extended and intricate work of Willstätter and others.

The sap-pigments may be divided into two main classes: (i) Derivatives of flavone or of flavonol —sometimes called anthoxanthines—which are pale yellow or colourless when in faintly acid solution, but bright yellow when dissolved in alkalis; and (ii) the anthocyans, which are red when in acid solution, violet to red-violet when neutral, and of varying tints from dull red, or red-brown, to purple and pure blue when in solution in the form of alkali salts. In both groups the individual pigments differ from each other in the amount of oxygen which they contain in the form of phenolic hydroxyl groups and the arrangement of these groups in the molecule.

We owe most of our knowledge of the distribution in Nature of the yellow sap-pigments—which usually occur in plant life in chemical combination with various sugars—to the work of A. G. Perkin, whilst the actual synthetic production of a number of these colouring matters by Kostanecki has confirmed our ideas concerning their chemical structure. How widely these pigments are distributed in Nature will be gathered from the fact that members of this group have been isolated from the following sources: Heather, wallflower, clover flowers, cotton flowers, delphinium flowers, onion skins, violas, poplar buds, parsley, etc. Although yellow sap-pigments derived from flavone have been isolated from a large number of plants and flowers, it is quite certain that pigments of this group are present in a very much larger number of plants than those from which they have up to the present been isolated.

When we turn to consider the pigments of the anthocyan class—the purples, reds, and blues of plant life—the fact of their extremely wide distribution is obvious to everyone. Their presence in petals or leaves is noticeable even where only a small fraction of 1 per cent. of the pigment exists in the flower. That this is so will be fully realised when the fact is considered that the blue cornflower contains only about 0·75 per cent. of its dry weight of the blue pigment cyanin. In contrast with this is the case which has come to light in recent investigations, where as much as 25 per cent. of the flower's dry weight of a yellow sap-pigment was present in a yellow viola, yet this large quantity was completely masked by a mere fraction of 1 per cent. of a plastid carotin colour that was present in the same flower.

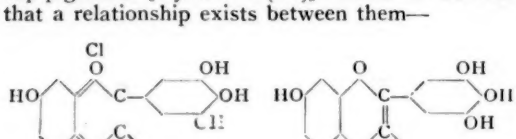
The great beauty of the anthocyan pigments has given rise to very numerous attempts to obtain an accurate knowledge of their chemical structure and also of their function in plant life. The name "anthocyan" dates back to 1835, and appears to have been introduced by Marquart. Despite the very numerous attempts that were made to isolate these pigments in a pure condition, it was not until 1903 that an anthocyan pigment (the colour of the pelargonium) was obtained in a crystalline condition by Griffiths. In 1913 Willstätter and Everest described their investigation of the pigment of the blue cornflower—which they called cyanin—and laid the foundation of the fuller investigation of the anthocyan pigments that has been developed since that date. It is to Willstätter, to his collaborators, and to Everest that we owe most of our knowledge of these pigments. The identity of a considerable number of the anthocyans has now been established, and pigments of this group have been prepared synthetically. Among others, the colouring matters of the cornflower, rose, pelargonium, viola, peony, hollyhock, cherry, and grape have been obtained in a pure condition and investigated. In almost every case these pigments occur in Nature chemically combined with sugars.

As the result of these chemical investigations the relationship that exists between the yellow sap-pigments derived from flavone and the anthocyan colouring matters has been made clear. This relationship has been the subject of much study by botanists, particularly by Keeble, Armstrong and Jones, and Wheldale, and it is interesting to note that, whilst botanical work appeared to point to the anthocyan colours being oxidation products of the yellow sap-pigments of the flavone series, chemical investigations have proved that the relationship is the reverse of this—the anthocyans are reduction products of the yellow sap-pigments.

Very interesting in connection with the function of these sap-pigments in plant life is the fact that, whilst chemical investigations have made it clear that the anthocyan pigments are reduction products of the yellow sap-pigments, botanical work strongly points to the conclusion that these very anthocyan pigments occur in plant life in positions that are the seat of oxidising influences.

It has been noticed by many who have investigated the anthocyan pigments that there is always at least a trace of yellow sap-pigment present alongside the red, purple, or blue of the anthocyan. From this has arisen the belief that the anthocyans are produced in Nature *via* the yellow sap-pigments, and recent work has shown that there is very considerable ground for thinking that this belief may prove to be correct.

To even the most uninitiated, the chemical formulæ representing a typical anthocyan [*e.g.* delphinidin (I.)] and the corresponding yellow sap-pigment [myricetin (II.)] make it obvious that a relationship exists between them—



(I.) (II.)

Naturally, to the horticulturist the interrelationship of the various sap-pigments to one another is of great interest; also the effect of these colours upon the tints produced by the plastid pigments that occur with them in plants and flowers. The proof, by chemical investigation, that the blue cornflower owes its colour to the same pigment as the red rose is of the greatest interest, for does it not raise hopes of success in the endeavour to produce a pure blue rose? In the rose the colour is red because the sap is acid, whereas the cell-sap in the cornflower is in such a condition that the pigment can take up enough alkali to form its blue alkali salt. Can the latter condition be reproduced in the rose?

It is often erroneously stated that the yellow sap-pigments are responsible for the yellow tints in flowers and berries, but in reality the bright yellows are almost exclusively due to plastid colours related to carotin, whilst the orange and brown tints are produced by combinations of these colours with those produced by pigments of the anthocyan group. In some few instances, however, it is probable that sap-pigments give rise to fairly strong yellows, but, in general, members of this class of compound produce pale yellow tints such as the colour of the primrose, or are present in an almost colourless condition in the acid cell-sap of white- or cream-coloured flowers. It is exceedingly difficult, even for one who has studied the pigments minutely, to be certain by mere observation which of the anthocyan pigments is present in any flower that may be examined. Chemical work has shown that plants of the same botanical group may produce different pigments, and, indeed, that more than one anthocyan, or yellow sap-pigment, may be present in the same flower.

Very naturally the clothing of Nature in such beautiful tints, as the result of the presence of these colours, led to the desire on the part of man to use them for the colouring of garments and other textile materials. Many of the members of the yellow sap-pigments are capable of industrial use as mordant dyes, and were largely so used before the synthetic colours became available. Some of them—*e.g.* fustic—are still employed in considerable quantities even in European countries. In the East quite a number remain in use. Concerning the dyeing properties of the anthocyan pigments, much doubt seems to have existed, but it appears certain that in 1850-60 the colour of the hollyhock was largely used in Bavaria for dyeing purposes. Quite recently these colours have been more fully investigated in respect of their dyeing properties, and it has been found not only that they dye wool, but also that they are capable of giving very fine shades when used on cotton with a tanning mordant. Although they have considerable tinctorial power, and the dyeings produced by them are fast to light, they do not stand washing sufficiently to make it possible for them to hold their own against synthetic colours.

Apart from the two main groups of sap-pigments, with which the above remarks have been concerned, there are quite a considerable number of coloured compounds that exist in plants in some soluble form—usually as glucosides. It should be noted that, whilst flavone or flavonol derivatives are very widely distributed, and the anthocyan pigments almost equally so, the remaining colours are much more restricted in their distribution. What *rôle* the flavones, either alone or accompanied by anthocyans, play in plant life, other than that of decoration, has not yet been discovered. Wide distribution is no indication of commercial importance as regards plant colouring matters, and some colours that are by no means widely distributed are of considerable importance. Furthermore, the question of plant colouring matters does not end with the consideration of those colours that exist ready-formed in the plant. Indigo, the most important of all plant colouring matters, exists in plant life as a soluble, colourless glucoside called indican, which produces indigo only when it loses the sugar with which it is chemically combined, and is oxidised by contact with air or other oxidising medium. The archil or cudbear group constitutes another class of colours that were formerly of commercial importance, and are produced from soluble colourless products present in various lichens. In conclusion, the important dye alizarine should not be omitted; this product was formerly obtained exclusively from plant sources—chiefly madder-root, in which it occurs partly as the glucoside ruberythric acid—whereas almost all the alizarine that is now used is prepared synthetically from the coal-tar product anthracene. It would appear that the time is not far distant when all plant pigments that are used for technical purposes will be displaced by synthetic products, but the recent shortage of synthetic dyes has certainly somewhat prolonged the commercial life of the various natural colouring matters.

Geodetic Survey in North America.[1]

THE United States Coast and Geodetic Survey has long had in progress an arc of primary triangulation along the 98th meridian of longitude. This arc was completed to the north, up to the Canadian boundary, in 1907. To the south there is a similar arc along the same meridian through Mexico, originally surveyed by the "Commission Géodésique Mexicaine" between 1906 and 1910, terminating to the north at the international boundary on the Rio Grande and extending southward to the Pacific Ocean.

It was obviously desirable that these two arcs should be connected, and it was accordingly arranged to make the connection in 1913, when the last section of the work in the United States was done. The internal condition of Mexico, however, did not permit any joint operations at that time, and a postponement was necessary. Opportunity was taken of the improved condition of the country in 1915 to revive the question. The arrangements proceeded without hitch and the final observations were successfully made in May, 1916. The publication under review gives an account of the southern end of this arc in Texas, surveyed in 1913, the junction with the Mexican arc in 1916, and a general summary of the progress to date of the lines of first order triangulation in the United States.

Since 1901 the Coast and Geodetic Survey has reduced all its work to a common datum and computed all positions and azimuths upon Clarke's 1866 spheroid. These, both datum and spheroid, have been accepted, on one hand by the Canadian, and on the other by the Mexican, Geodetic Surveys, so that they are now common to the whole of North America. An inspection of the index map of the triangulation lines in the United States computed to these data shows, however, that there is still a considerable block of triangulation in the Eastern States not yet readjusted. When this readjustment is made and when certain lines in the Central and Western States, now in progress, have been completed, the network over the whole area will be so close that no point will be situated at a greater distance from a main triangulation line than about 170 miles. In fact, even this distance will be rarely attained, and over almost the whole area the maximum distance will be under 150 miles.

Such a network of absolutely first-class work is amply sufficient to satisfy the most exacting geodesist and is, of course, more than a sufficient basis for any possible map upon any practical scale. We may, therefore, congratulate the U.S. Coast and Geodetic Survey upon the now not distant completion of one of the main sections of its great task.

[1] Department of Commerce, U.S. Coast and Geodetic Survey. Geodesy. Serial No. 97. Report on the Connection of the Arcs of Primary Triangulation along the Ninety-eighth Meridian in the United States and in Mexico, and on Triangulation in Southern Texas. By William Bowie. (Special Publication No. 51.) Pp. 93. (Washington: Government Printing Office, 1919.) Price 10 cents.

The execution of the small section of triangulation under review was marked by no special technical advances; but as exhibiting a high level of technical efficiency and as being of possible use for future guidance in similar work that may be planned in British territories, we may briefly advert to one or two practical points. One question of considerable importance is to decide whether it is desirable to restrict observations to the night or whether day observations should be included. The U.S. Survey adopts the principle of allowing only night observations, for the stated reason that experience has shown that there is less deviation in the geodetic azimuths of the lines when this restriction is enforced than when the observing is done by day or is a combination of day and night work. In other words, the atmospheric conditions are more stable at night and observations of angles, therefore, more accurate. This is in accordance with general experience and practice. It has, however, been argued, not without a certain show of plausibility, that though undoubtedly the apparent errors are thus reduced, this may be at the risk of introducing systematic errors, due, let us say, to unsymmetrical atmospheric refraction operating only when observations are made upon a falling temperature, which might be eliminated if observations under different atmospheric conditions were combined. Though plausible, this argument is, we think, not tenable, or, perhaps more correctly, not applicable to the case of a triangulation.

The ultimate test as to whether, in deriving the most probable mean of any set of observations, systematic errors are likely to be diminished by the inclusion of observations of an inferior degree of accuracy but differing in their conditions can be decided only by experience. Now in this case the "experience" is immediately available, being, in fact, implicitly contained in the figure expressing the closing error of the triangle. Any method of observation and any system of combining the results of the observations into a mean value which reduce this closing error *ipso facto* increase the probable accuracy of the finally derived figures of position and azimuth. Night observations, preferably between, say, three hours after sunset and one hour before sunrise, fulfil this condition and are therefore rightly accepted as ideal.

The U.S. Survey, operating over a huge area with a necessarily limited budget, has perforce to pay attention to the question of cost. Survey is, in fact, on exactly the same basis as other engineering operations. The problem is to get the maximum output of work of a strictly defined and practicable degree of precision at the minimum cost, and not, as has sometimes been assumed, to reach the highest attainable precision regardless of cost.

The standard for first order work in the United States is an average triangular error of one second of arc and a maximum error of under three

seconds. This already high degree of precision was, however, surpassed in the particular section under notice. Thus over a total of sixty-eight triangles the average closing error was 0·63″ and the maximum error of any one triangle 1·86″. This pitch of excellence was moreover attained without any increase of time spent at the stations; indeed, it is claimed, we think with justice, that the arc establishes a "record," both technically and financially. The average cost per point occupied was, in fact, lower than has been attained with any previous work of the same class, and as, owing to the nature of the country, high and expensive signal scaffolds were necessary, it seems that the reduction made in the cost of the actual observing was even more notable than appears on first inspection.

This conveys a lesson which may be taken to heart by those responsible for future survey operations. It seems clear that the difference in method of execution between what we are accustomed to call first order or primary triangulation (*i.e.* triangular error under 1″) and secondary work (triangular error under 3″) lies mainly in the nature of the signals. If lamps only are used it is a matter of indifference as regards rate of progress, and hence as regards cost, whether a large instrument capable of first order precision or a smaller one capable only of second order is used. In either case one observer can complete the observations at a station in one night, and no reduction in size of instrument, in number of rounds taken, or in order of accuracy will enable him to do more. The difference in cost of transport between the two instruments is in most cases negligible. The only extra cost involved is that caused by the necessity of providing five lampmen or lamp parties and moving them from point to point. In rough country this might undoubtedly prove a formidable addition, but in the case of future boundary commissions or land surveys in Africa it is anyhow worth serious consideration whether a backbone or net of primary triangulation, planned so as to fit in with a comprehensive geodetic scheme, cannot be undertaken without a prohibitive increase in expenditure.

This is the sort of question for which the coordinated experience and authority of a geodetic institute would prove invaluable, and it is to be hoped that it will not be long before such an institution, long overdue, is established in England for the British Empire. E. H. H.

Science and Research in the Air Service.

THE Air Estimates for the year 1920–21, recently presented to Parliament, show a total estimated expenditure of 21 million pounds compared with 54 million pounds in the previous year. The apparent saving in cost is 33 millions, but it is really greater, for in the year 1919–20 the cost of the experimental and research services was borne jointly by the Admiralty and the Ministry of Munitions, and is now wholly included in the Air Ministry vote.

As regards the Royal Air Force, the number of officers, warrant officers, non-commissioned officers, airmen, and boys provided on the establishment (exclusive of those serving in India) has fallen from 150,000 in 1919–20 to rather less than 30,000 in 1920–21—a striking reduction. The 21 million pounds for the new financial year includes rather under a million for civil aviation and two and a half millions for experiment and research. This latter sum would have been more than three millions (3,177,000*l.*) had not an "appropriation in aid," due to the sale of certain airships for 600,000*l.*, come to the relief of the vote. The actual figures are as follows:—

	£
Liquidation of war liabilities	1,334,000
Works, buildings, and lands	140,000
Aeronautical inspection	80,300
Airship constructional establishment ...	315,000
R.A.E., Farnborough	401,200
Technical equipment and materials ...	844,390
Salaries and wages	48,800
Miscellaneous	13,850
	3,177,540

An expenditure of more than three millions for research alone in a single year would appear to be a generous provision, but an examination of the foregoing figures shows that much of the expenditure will not be employed for this purpose.

The air vote for meteorological services has risen from 12,000*l.* in 1919–20 to 77,629*l.* in 1920–21, and part of this will doubtless be used in research work of some kind, though these services are not part of the research directorate, but come under the civil aviation side of the Air Ministry. The sum of 77,629*l.* includes the provision of only 358*l.* for "experimental stations," which is such a very modest amount that we assume experimental research in meteorology is provided for by other aid. In any event, the amount cannot represent the degree to which attention is given to research, since in meteorology there is ample scope for original work based upon the observations from what may be termed routine stations.

The printed Estimates convey the intention of the Government to make liberal provision for research in aeronautics, but it is impossible to determine precisely what sum of money is thereby devoted solely to "experiment and research," since such work is sometimes carried on at the ordinary air stations. Moreover, 40,000*l.* for the National Physical Laboratory is not borne on the Air Estimates at all, but on those for the Civil Service. The Estimates do, however, include the sum of 20,340*l.* for research "grants to scientific bodies," and 600,000*l.* as an encouragement to invention.

Obituary.

MR. SEDLEY TAYLOR.

THE long life of Mr. Sedley Taylor, who died recently at the age of eighty-five years, nearly all of which were spent in public activities at Cambridge, was in many ways notable. Theology, mathematics, physical science, practical economics, and pre-eminently music, occupied his attention. His withdrawal from active theological pursuits (in 1863 he was ordained to a curacy near Birmingham) was not merely a personal event; it was also linked up with the movement for greater academic freedom at Cambridge. About the same time Henry Sidgwick (1869) and Leslie Stephen (1862) gave up their fellowships. So early as 1862 appeared the first edition of Helmholtz's classical treatise on the sensations of tone. A translation into English, published by A. J. Ellis in 1875, increased its reaction in this country both on the physical theory of sound and on the æsthetic principles of music, which it for the first time brought into detailed, reasoned connection. Its influence was much forwarded by Sedley Taylor's book, "Sound and Music," which appeared in 1873, and was the earliest general exposition in short compass by a writer competent on both sides of the subject. An event which his characteristic energy rendered prominent was his invention of an apparatus which he named the phoneidoscope. It consisted essentially of a resonant cavity, with an aperture over which a soap-film was stretched: when the operator sang to it a note nearly in unison with the cavity, the aerial vibrations revealed themselves visibly in whirling movement of the coloured striations of the liquid film.

In these days perhaps such phenomena, now more fully understood, would be regarded as bearing more closely on the properties of the very remarkable structure exhibited by bubbles, being too complex to reveal direct knowledge of the constitution of sound waves.[1] But Sedley Taylor's enthusiasm was infectious. As a testimony to his zeal in connecting up music with acoustics, and also to the relevant state of things in Cambridge at this period, an extract from Clerk Maxwell's Rede Lecture of 1878 on the telephone (then newly discovered) is worth quoting:—

> Helmholtz, by a series of daring strides, has effected a passage for himself over that untrodden wild between acoustics and music—that Serbonian bog where whole armies of scientific musicians and musical men of science have sunk without filling it up. We may not be able even yet to plant our feet in his tracks and follow him right across—that would require the seven-league boots of the German Colossus; but to help us in Cambridge we have the Board of Musical Studies vindicating for music its ancient place in a liberal education. On the physical side we have Lord Rayleigh laying our foundation deep and strong in "Theory of Sound." On the æsthetic side we have the University Musical Society doing the practical work, and, in the space between, those conferences of Mr. Sedley Taylor, where the wail of the Siren draws musician and mathematician together down into the depths of their sensational being, and where the gorgeous hues of the Phoneidoscope are seen to seethe and twine and coil like the
>
> "Dragon boughts and elvish emblemings"
>
> on the gates of that city where
>
> "An ye heard a music, like enow
> They are building still, seeing the city is built
> To music, therefore never built at all
> And therefore built for ever."
>
> The special educational value of this combined study of music and acoustics is that, more than almost any other study, it involves a continual appeal to what we must observe for ourselves.
>
> The facts are things which must be felt; they cannot be learned from any description of them.

[1] The writer is indebted to Sir Joseph Larmor for assistance on this subject.

The economic side of Sedley Taylor's work can be illustrated by a conversation with a younger friend of his who was accustomed to see him in his rooms in Trinity College during his last years of feeble health. The talk turned upon profit-sharing, which was introduced by a question about a French statuette on the mantelpiece. To his surprise the younger man, who had to probe for his information, found that Sedley Taylor had been a pioneer, had even been the inventor of that term, and had written a book on the subject, for which he had been decorated for his services towards industrial co-partnership by the French Government, which was at the time closely interested in such matters.

Sedley Taylor was a pioneer in at least two other directions. One of them was the higher education of women. He promoted the foundation of Girton College, and was afterwards its constant benefactor. Towards the end of his life, in 1911, he received the honour of the freedom of the borough of Cambridge for establishing and endowing the first dental clinic that was founded in England. His musical activities pervaded Cambridge, and are too widespread to be discussed here. His generosity, kindliness, and humour endeared him to a wide circle, and in particular to many generations of musical undergraduates.

CYRIL ROOTHAM.

WE regret to note that the death of MR. ANTHONY GEORGE LYSTER is announced in *Engineering* for March 19 as having taken place on March 17 at sixty-eight years of age. Mr. Anthony Lyster was the second son of Mr. G. F. Lyster, of Liverpool, and father and son between them were responsible for the greater part of the port developments on the Mersey over a period exceeding fifty years. Mr. Lyster was educated at Harrow, and served his pupilage under his father. After holding the position of assistant engineer to the Mersey Dock Board for some time, during which he was responsible for the

construction of important new works, he succeeded to the position of acting engineer-in-chief, and became engineer-in-chief in 1898. He resigned this post in 1913, and then became a partner in the firm of Sir J. Wolfe Barry and Partners, but remained consulting engineer to the Mersey Dock Board until the time of his death. Mr. Lyster became a member of the Institution of Civil Engineers in 1882, and was president in 1914. He served as a member of the International Technical Commission for the Suez Canal, and was consulted with regard to improvements of the harbours at New York, Bombay, Port Elizabeth, Shanghai, etc. He was also a member of the Admiralty Committee on Naval Works at Doon and Rosyth, and associate professor of engineering at Liverpool University.

By the death of Mr. W. A. E. Ussher, which occurred on March 19, many British geologists will lose an old friend who, whether in his usual mood of breezy optimism, or in a rarer phase of boisterous pessimism, was always good company. Mr. Ussher joined the Geological Survey in 1868 and was engaged in the mapping of various parts of England, but his name will always be associated with the Devonian, Carboniferous, and New Red rocks of Devon, Cornwall, and Somerset, where he spent most of his official career. His principal contributions to the literature of these formations appear in the Memoirs of the Geological Survey, in the Journal of the Geological Society, and in the Transactions of the Devonshire Association. In his study of the West Country rocks it was his constant endeavour to secure correlation with their European equivalents, and thus he was brought into close association with many Continental geologists of note. In 1914 he was awarded the Murchison medal of the Geological Society in recognition of his labours. Mr. Ussher retired from the Survey in 1909; unfortunately, ill-health since then kept him in almost complete retirement.

By the comparatively early death of Dr. R. C. Maclaurin on January 15 last, the United States have lost an accomplished and energetic immigrant. Dr. Maclaurin was born at Lindean, Scotland, in 1870, and in 1897 was placed in the first division of the first class of the advanced part of the Mathematical Tripos. It was an unusually good year, the candidates including Grace and Bromwich. Dr. Maclaurin was also equal for the second Smith's prize. After graduating, he at first turned his attention to law, but before very long became professor of mathematics in the University of New Zealand. This post he left in 1907 to occupy the chair of mathematical physics at Columbia, N.Y., and two years later became president of the Massachusetts Institute of Technology. He published one legal treatise, and two on the theory of light; besides this, he contributed various papers to the Philosophical Transactions and other periodicals.

Notes.

A list of 5604 promotions in and appointments to the Civil Division of the Order of the British Empire "for services in connection with the war" was published on March 30 as a supplement to the *London Gazette*. We notice the following names of men of science and other workers known in scientific circles:—*Knight Grand Cross (G.B.E.)*: Dr. A. E. Shipley, F.R.S., Vice-Chancellor of Cambridge University. *Knights Commanders (K.B.E.)*: Prof. I. Bayley Balfour, F.R.S., University of Edinburgh; Prof. W. H. Bragg, F.R.S., University College, London; Dr. S. F. Harmer, F.R.S., Director of Natural History Departments, and Keeper of Zoology, British Museum; and Dr. J. E. Petavel, F.R.S., Director of the National Physical Laboratory. *Commanders (C.B.E.)*: Prof. H. L. Callendar, F.R.S., Imperial College of Science, London; Dr. C. C. Carpenter, chairman, South Metropolitan Gas Co.; Mr. F. H. Carr, Chief Chemist, Messrs. Boots Pure Drug Stores; Prof. F. G. Donnan, F.R.S., University College, London; Mr. W. P. Elderton; Mr. A. P. M. Fleming; Prof. P. F. Frankland, F.R.S., University of Birmingham; Dr. F. W. Edridge-Green; Prof. W. A. Herdman, F.R.S., University of Liverpool; Prof. J. C. Irvine, F.R.S., University of St. Andrews; Mr. J. G. Lawn; Prof. T. M. Lowry, F.R.S.; Mr. W. Macnab; Dr. R. A. O'Brien, Director, Wellcome Physiological Research Laboratories; Mr. J. E. Sears, National Physical Laboratory; Mr. F. J. Selby, National Physical Laboratory; Dr. T. E. Stanton, F.R.S., National Physical Laboratory; Mr. G. Stubbs, Government Laboratory; Lieut. J. R. F. Wild, member of Sir E. Shackleton's Antarctic Expedition; and Dr. Dawson Williams, editor, *British Medical Journal*.

The impending retirement of Sir Napier Shaw, who has been the Director of the Meteorological Office since 1905, and as president of the International Meteorological Committee occupies a unique position, marks an epoch in the history of British meteorology. Trained primarily as a physicist, Sir Napier has been able to approach meteorological problems in a scientific spirit. His academic experience brought him into contact with younger men, and by the encouragement he extended to them he raised the level of his subject. As a consequence, there are at the present moment a greater number of men in the British Empire capable of dealing with intricate meteorological problems than in any other part of the world. A heavy responsibility rests on the authorities on whom the duty of nominating Sir Napier's successor falls. When the Meteorological Office was taken over by the Air Ministry last year the change was looked upon with grave misgivings. The near future will show whether the anxiety then felt regarding the wisdom of a step that was taken against the advice of all competent authorities is to be relieved or intensified. It would be an irretrievable calamity if administrative rather than scientific qualifications were to determine the choice. Unless the whole future of British meteorology is to be

jeopardised, the Director of the Office must be a man of high scientific standing who will maintain the leading place which the Office now takes among the nations of the world. For the credit of the nation and in the interests of science we trust that the new Director will be a worthy successor of the one who has given so much scientific honour to the post.

MR. C. E. GROVES, F.R.S., for some years lecturer in chemistry at Guy's Hospital, consulting chemist to the Conservators of the River Thames, and vice-president of the Chemical Society from 1899-1902, who died on February 1, left estate of the gross value of 33,022*l*., of which amount 20,000*l*. is left in trust for his five sisters for life, and on the death of the survivor of them 10,000*l*. to the Royal Institution for the Groves Endowment Fund for the promotion of scientific research.

TWO scholarships, each of the annual value of 300*l*., are being offered by the Grocers' Company, the object being the promotion of original research in sanitary science. In addition to the sum named, there will be an allowance to meet the cost of apparatus and other expenses in connection with the work. The scholarships will be tenable for one year, but may be extended for a second or third year under certain conditions. The elections will take place in June next, and applications have to be made, on a special form provided, before May 1 to the Clerk of the Grocers' Company, Grocers' Hall, Princes Street, E.C.2.

IN spite of the fact that no regulations have been issued concerning standard time in Finland, Helsingfors time (1h. 4om. fast on Greenwich time) has been almost generally adopted in the country. The inconvenience of following a time which differs from the international zone system based upon Greenwich time was the principal cause of a proposal, made last autumn by the Geographical Society of Finland, to fix Greenwich time +2h. as the standard time of the Republic. A correspondent, "H. R.," informs us that on March 12 the President arrived at a decision in accordance with this proposal. The new standard time of Finland will be adopted by the railways from May 1, 1921, and the calendars for 1921 will introduce it from the beginning of the year. The question of adopting the twenty-four-hour day is under discussion.

THE Works Council Bill has now passed into law in Germany. It provides for the formation of a works council in every works having at least twenty employees (operatives and office staff). Representation then proceeds *pro rata* up to a works employing any number. All male and female workers from the age of eighteen who are in possession of citizen rights are entitled to vote. Among the various provisions of the Act mention may be made of the obligation of the councils in assisting the management by advice with the view of obtaining the greatest economy in carrying out manufacturing operations. They must also co-operate in the application of new methods and in preventing disputes, and assist in the welfare work, etc. These provisions presuppose considerable technical and industrial knowledge on the part of the members of the council—which, it may be added, must not exceed thirty in any one establishment.

AT the annual general meeting of the Chemical Society, held at Burlington House on March 25, the following were elected officers and council for the ensuing year:—*President:* Sir James J. Dobbie. *Vice-Presidents:* Prof. J. B. Cohen, Prof. F. G. Donnan, Dr. H. J. H. Fenton, Prof. S. Smiles, Prof. J. Walker, and Prof. W. P. Wynne. *Treasurer:* Dr. M. O. Forster. *Secretaries:* Dr. J. C. Philip and Dr. H. R. Le Sueur. *Foreign Secretary:* Dr. A. W. Crossley. *Ordinary Members of Council:* Prof. A. J. Allmand, Dr. E. F. Armstrong, Julian L. Baker, Francis H. Carr, Prof. A. Findlay, Prof. F. E. Francis, J. A. Gardner, Prof. J. C. Irvine, Dr. C. A. Keane, Sir Robert Robertson, Prof. J. M. Thomson, and E. W. Voelcker. It was announced that, the supplementary charter now having been granted, an extraordinary general meeting of the fellows would be held at Burlington House on April 29 at 5 p.m. to consider the alterations in the by-laws proposed by the council.

WE have on several recent occasions referred to the advances which were made during the war in wireless telephony to and from aeroplanes. There is also another important use to which electric waves have been put in connection with aerial navigation, in the wireless direction-finding apparatus, which has likewise been brought to a considerable degree of perfection. An interesting demonstration of both these applications was given under the auspices of the Marconi Co. on a Handley Page machine on March 25, when conversations were held with the Marconi establishment at Chelmsford, and messages were picked up and transmitted to the *Times* office in London. The direction-finding apparatus, which was also demonstrated, is apparently a development of the "wireless compass" used at sea, founded on the radio-goniometer of Bellini and Tosi, in which the angular relation of two coils connected respectively to two independent aerial systems at right angles is varied. By rotating a pointer carrying one of these coils a position is found where the signals received reach a maximum loudness and the direction of the incoming waves is ascertained. By plotting cross-bearings of two stations obtained in this way on a chart, the true position can be found. The Marconi form of the apparatus has a working range of 200 to 300 miles when used in conjunction with low-power coast wireless stations. The converse process was used during the war for finding the position of enemy craft from more than one home station, and it is well known that the Zeppelins used a wireless position-finder extensively for navigation during raids. The principle on which this worked is, however, believed to have been somewhat different.

THE report of the Royal Commission on Decimal Coinage has just been issued. The majority report, which represents the views of about two-thirds of the members of the Commission, is not in favour of making any change in the denomination of the currency and money of account in order to place them

on a decimal basis. It maintains that this decision is justified by the following considerations:—(1) In any scheme for reducing the existing system to a decimal basis the pound should be retained. (2) The pound and mil scheme is the only strongly supported scheme which complies with this condition. (3) The advantage to be gained by a change to the pound and mil scheme as regards keeping accounts is in no way commensurate with the loss of the convenience of the existing system for other purposes. (4) Grave difficulties will be created by any alteration of the penny. (5) The scheme cannot be tried as an experiment or on a voluntary basis. There are two minority reports in favour respectively of the decimalisation proposals of Lord Southwark and Lord Leverhulme. The investigation makes it clear that many of the difficulties now regarded as insuperable would disappear if our system of weights and measures were such as to familiarise the general body of the community with decimal calculation. This fact will, no doubt, stimulate the advocates of the metric system to renewed efforts to bring about this useful and necessary reform.

DR. R. C. SMITH states in the *Scientific Monthly* for February that there is in the popular mind a surprisingly large amount of misinformation and misconception concerning many forms of natural history, and this is not confined to exotic, but extends to well-known plants and animals. As instances he quotes the belief that the beaver uses its tail like a trowel; that the porcupine shoots its quills at enemies; that certain squirrels and fish fly; that snakes swallow their young in times of danger; that cats suck the breath of babies, and so on. The prevalence of these beliefs is due largely to the fact that a considerable portion of the people do little or no reading, or it is confined to trashy literature. These misconceptions are due to various causes—to hasty acceptance of the opinions of others, to mistaken observation and misinterpretation of the facts involved, but mostly to the fertility of imagination. All this points to the necessity of serious and efficient Nature-teaching in schools, by the agency of which misinformation about well-known objects of natural history can be corrected.

WE congratulate the Hunterian Museum at Glasgow University on its year's record of steady progress. In the Reports on the Hunterian Collections for the Year 1918–19 just received we note especially the growth of the collections of insects of economic and sanitary importance, through the enthusiastic work of Mr. R. A. Staig. The long list of acquisitions in this department bears witness both to Mr. Staig's energy and to the admirable lines upon which he is developing the collection. The geological collections have received a valuable acquisition through the purchase of the balance of the important Leeds collections of fossil reptiles and fishes from the Oxford Clay. The honorary curator of the coin cabinet reports that the resumption of international communication has been responsible for a considerable increase in the number of requests for casts from workers abroad, and the list of consignments dispatched is eloquent at once of the world-wide fame of this museum and of what the war has meant to research workers at home and abroad.

AMONG early palæolithic flint implements found in the river gravels of the South of England there are certain specimens with the point slightly turned to one side. These are regarded as intermediate between the still older rostro-carinate flints and the ordinary palæoliths by Mr. J. Reid Moir, who describes seven examples in detail and discusses them in a recently published part of the Philosophical Transactions (vol. ccix., B, pp. 329–50, pls. 51–57). According to this explanation, the makers of the rostro-carinate implements eventually began to increase the efficiency of their tools by extending the ridge of the beak progressively further towards the butt end, while they chipped the edges of the great flat face until it also became a longitudinal ridge similarly extended. The rostro-carinate implement, triangular in cross-section, thus passed into the palæolithic implement of the "river-drift type," rhombic in cross-section; the two opposite flat faces of the former having been chipped away, and the two opposed great surfaces of the latter being in planes at right angles to them. As the cross-section of a rostro-carinate resembles that of a dog-fish, while the cross-section of an ordinary palæolith corresponds with that of a plaice, Sir Ray Lankester suggests that the latter should be described as platessiform. Other early palæoliths in which one face is flat may have originated from the rostro-carinate type simply by the extension of the ridge of the beak and the simultaneous thinning of the flint, thus resulting in a skate-like or batiform shape.

IN the *Philippine Journal of Science* (vol. xiv., No. 4) Mr. E. D. Merrill continues his work on new or noteworthy Philippine plants. The present contribution contains descriptions of one hundred new or presumably new species, and eighteen new records for the islands. Of the nine genera which are for the first time recorded as Philippine, two are of special interest from the point of view of geographical distribution. One, Cloezia, a genus of Myrtaceæ, has hitherto been known only from New Caledonia, where it is represented by six species. The discovery of a representative in Mindanao, in forest at an altitude of 1700 metres, adds another genus to the remarkable list of genera that are known only from the Philippines and the islands to the south and south-east of the archipelago. The second, Citriobalus, is a small Australian genus of Pittosporeæ, with one species from Java, the range of which is now extended to Luzon. Another Australian species, *Ipomoea polymorpha*, previously known only from Australia and Formosa, has also been found in Luzon.

ABSTRACTS of scientific papers, when giving full bibliographical details and fully indexed, are evidently of greater utility than mere catalogues. An excellent series of abstracts has for many years been prepared by the Chemical Society, and *Science Abstracts*, issued by the Institution of Electrical Engineers and the Physical Society, is a well-known publication. The abridgments of the Patent Office point to the use of abstracts for purposes of search. Within the last

few years the question of abstracting and cataloguing scientific literature has been much discussed, and has become acute. The Mineralogical Society has, on its own initiative, made a start in this direction, and has recently issued the first number of a series of *Mineralogical Abstracts*. This will give notices of papers and books dealing with purely scientific mineralogy and crystallography, and will also direct attention to matters of mineralogical interest in original papers bearing more on petrology, ore-deposits, and economics. The work of abstracting is being carried on by voluntary helpers, but even with this help it is evident that the cost of printing will be more than a small society can bear. It is hoped, if this venture proves to be of some general use, that it may lead to an increased membership of the society.

MUCH attention has been given in recent years to the question of manufacturing alcohol within the Empire for use as motor spirit. In the current number of the Bulletin of the Imperial Institute the possibility of utilising the mowra flowers of India for the purpose is discussed. These flowers possess thick, juicy petals rich in sugar. They are used by the natives as a foodstuff, and especially for the preparation by fermentation of an alcoholic liquor called daru or mohwa spirit. A single tree will yield as much as 200–300 lb. of flowers in a year. The tree also produces a valuable oil-seed, which is exported in fairly large quantities to Europe. During the war the flowers were used in India for the production of acetone, the yield being said to be ten times as much as that obtained by distilling wood, which is the usual source of this substance. The demand for acetone in India in peace times, however, is not great, and large quantities of the flowers would be available for the manufacture of alcohol, and would appear to be an exceptionally cheap source of this material, as the yield is high compared with that from potatoes and other materials commonly used, about 90 gallons of 95 per cent. alcohol being obtainable from one ton of dried flowers. It has been estimated that in the Hyderabad State alone there are already sufficient mowra-trees for the production of 700,000 gallons of proof spirit per annum, in addition to that necessary for the local liquor requirements.

IN the Weekly Service for February 21, issued by the Ministry of Agriculture and Fisheries, there appears some interesting information on the prospective yields of cereals for the season 1919–20. From this information, obtained from the International Agricultural Institute of Rome, it seems that the world is faced with a considerable reduction in its wheat supply. In Australia the yield of wheat for 1919–20 is estimated at 54·4 per cent. of the previous year's production, and this is only 38·3 per cent. of the average of the five preceding years. Similarly, the estimated wheat yield is much lower than last year's average in the Union of South Africa, the United States of America, Rumania, and Argentina. Before the war the average exports of wheat from Russia and India were together equal to the quantity imported into the United Kingdom from all sources, but it will be some time before India can recover from the famine conditions of 1919, while it is highly probable that Russia will not rank as a wheat-exporting country for the next few years. There is, therefore, a vital need for an increased wheat production in the United Kingdom. Not only for this reason, but also because the scheme is thoroughly sound from the practical point of view, the Ministry advises the sowing of spring wheat, and gives practical advice as to varieties, soils, etc.

THE Journal of the Royal Statistical Society for January contains an interesting summary of the growth of Canada (1867–1917), "Fifty Years of Canadian Progress," by Mr. Ernest H. Godfrey, of the Dominion Bureau of Statistics, Ottawa. While Prince Edward Island and the North-West Territories show an absolute decline in population in the period 1871–1911, the total population was nearly doubled, and that of Manitoba increased from 25,228 to 455,614. More than a third of a million immigrants entered Canada in each of the three years 1912–13–14. The acreage and yield of wheat were more than doubled in the decade 1900–10, those of oats increased by two-thirds, and these rates of development were maintained until 1917. In 1870 Ontario produced 85 per cent. of the wheat, 82 per cent. of the barley, and 52 per cent. of the oats of the Dominion; since 1900 the main farm crops have been obtained further west, Saskatchewan producing in 1917 56 per cent. of the wheat, 28 per cent. of the barley, and 34 per cent. of the oats. While the numbers of sheep have steadily declined (1871–1911), those of horses have doubled and of cattle have increased by 50 per cent. Canadian cheese factories produced annually from $1\frac{1}{8}$ to nearly 2 million cwt. (1893–1917), nearly all of which was exported to the United Kingdom. In 1867 there were 2288 miles of railway line; in 1881, 7331; and in 1917, 38,604. The mineral census of 1911 was of so different a character from those of earlier years that it is not possible to quote details of the progress in mineral wealth. The paper is worthy of close attention by all who are interested in Canada.

GEOGRAPHERS are not likely to overlook the continuous exploration and illustration of Alaska by the officers of the United States Geological Survey, further evidence of which is seen in Bulletins 683 and 687, dated 1918 and 1919 respectively. The former contains a number of new maps, where much still remains a blank, of country stretching in from the coast north and west of the Lower Yukon River. The latter provides excellent photographic views, notably plates v. and vii., of the Kantishna region, north of Mount McKinley, where the only population consists of some forty whites engaged in mining.

IT is a pleasure in these times to handle and read so well printed a report as that which inaugurates the "Scientific Survey of Porto Rico and the Virgin Islands" (vol. i., part 1, issued by the New York Academy of Sciences, 1919). The origin of the survey of this outpost-island of the United States is given by Mr. N. L. Britton, and Mr. C. P. Berkey furnishes an introduction to the general geology. The

rocks of Porto Rico divide themselves into an older series, mainly volcanic, which is regarded as Cretaceous or a little earlier, and a sedimentary Cainozoic group, determined by marine fossils to be of Eocene, Oligocene, and Miocene age, Oligocene beds largely predominating. Though it is not mentioned on the cover of the part, a good map of the island, by Messrs. Reeds and Briesemeister, faces p. 30. The scale is 1 : 950,400, and red contours are sketched at 100 ft., 500 ft., 1000 ft., and 1500 ft. In his detailed account of the geology of the San Juan district Mr. Douglas R. Semmes describes the very interesting and very annoying topography of the Tertiary limestone belt, where "pepinos"—we prefer this term, meaning "cucumbers," to Mr. Berkey's "haystack hills" adopted in the paper—give rise to a remarkably broken country. This topography is due to the irregular falling-in of waterways in the Cainozoic limestone, complicated by the occurrence of beds of shale. In the petrographic section we welcome the appearance of Vogelsang's term "vitrophyre"; but the German spelling that is retained, even in a plural, which is written "vitrophyrs," makes us fear that this useful word is here limited as Rosenbusch desired.

AERIAL navigation has become of such vast importance that any aid which meteorology can afford is welcomed, while, on the other hand, the meteorologist looks with much expectation to the airman for observations which may advance our knowledge of the general movements of the atmosphere. The Meteorological Office has just issued "An Analysis of Cloud Distribution at Aberdeen during the Years 1916–18" (Professional Notes No. 9, price 4*d*. net). The analysis is by Mr. G. A. Clarke, assistant at Aberdeen Observatory. It is practically a first effort at averaging the number of days in each month on which certain cloud characteristics are predominant, and from this deducing by the estimated average height of the cloud the occasions when air was cloud-free below certain heights. The number of occasions upon which flying would have been handicapped on account of the lowness of the cloud is 31 per cent. of the total, and of the remainder rather more than one-third show no cloud below 7000 ft. The weakness of the analysis is that the cloud-heights have been worked on average results deduced from altogether different observations. It is recognised by meteorologists not only that the heights of clouds may vary at different stations, but also that they are subject to diurnal and seasonal variations.

IN a paper on operating a by-product producer-gas plant for power and heating, read recently at the Institution of Electrical Engineers, Mr. W. H. Patchell gives particulars of the running of a plant belonging to the Hoffmann Manufacturing Co., Ltd. The gas plant is on the Lymn system, and the power units consist of four-cylinder horizontal Premier engines of about 500 brake-horse-power at 190 revs. per min. Each gas engine is fitted with an exhaust boiler, and the boilers were installed with water-heaters. The dynamos were supplied by Messrs. Crompton, and are open type direct-current shunt-wound interpole 360-kw. machines running at 190 revs. per min.; the first two machines work at 110 volts, and in the second instalment of plant, machines working at 220 volts are used. The figures obtained for a period of six months' running show a consumption of 1·51 lb. of coal per kw.-hour, and a thermal efficiency of 19·9 per cent. on the units delivered to the feeders. The best figure quoted by Mr. David Wilson (Technical Adviser to the Controller of Coal Mines) for electric power stations in the South of England is a consumption of 2·32 lb. of coal per unit and a thermal efficiency of 13·05 per cent. The best station in the Northumberland district gave 1·80 lb. of coal per unit and a thermal efficiency of 18 per cent. Mr. Patchell considers that the large-cylinder high-power gas engine will be developed in this country as it has been abroad—an opinion in which he appears to differ from some other gas-engine authorities.

A PAPER read to the North-East Coast Institution of Engineers and Shipbuilders on March 19 by Dr. W. H. Hatfield, of the Brown-Firth Laboratories, and Mr. H. M. Duncan, of Messrs. C. A. Parsons and Co.'s Research Laboratory, deals with the mechanical properties of turbine steels. Unfortunately, the authors were unable to obtain specimens of turbine steel which had done good service in severely stressed parts, and a standard with which they could compare other steels was therefore lacking, but the conclusion is reached that design has probably more to do with the life of turbine parts than the quality of the steel. One disc which failed in practice, however, proved to be weak when tested in a radial direction, and the defects of structure are illustrated by means of photomicrographs. The paper contains a number of tests by different methods, the conclusions as to the relative value of impact, bending, hardness, and tensile tests being, in the main, the same as those reached by Dr. Hatfield in his paper read before the Institution of Mechanical Engineers. An investigation of the Sankey test is included, the relation between the length, diameter, and resistance of the test piece being examined. A formula is given which yields a rough approximation to the values which would be obtained under standard conditions. Formulæ are also given for the Stanton repeated impact test, and the data collected should be of interest to engineers who are concerned with testing.

SOME interesting particulars regarding the use of mechanical reduction gears between the turbines and the propeller in the Royal Navy were given in a paper read at the recent meeting of the Institution of Naval Architects by Eng.-Comdr. H. B. Tostevin. By 1916 it was considered that enough progress had been made to warrant a complete change-over to this type of driving, and at present there are installed or on order 612 sets of gears of a total horse-power of 7,828,000. The largest set transmits 36,000 shaft-horse-power, and there are four sets on this ship, totalling 144,000 h.p. In all naval work the turbine spindles, pinions, and gear-wheels are supported on rigid bearings, and the alignment is determined by accurate machine work in boring the gear housings and fitting the bearings. In general, a gearing ratio

of 8 or 9 to 1 is not exceeded in naval practice of moderate and high power. Of the 556 sets in service, some extending up to nearly six years, it has only been necessary to remove three for refit due to misalignment; no actual breakdown occurred, and the gears, after dressing up, were afterwards re-utilised. Two cases of fractured teeth occurred; the broken or cracked portions were removed and the damaged teeth were smoothed up. There is a great saving in the blading of the turbine by the adoption of mechanical gearing, amounting in the case of a destroyer to 70,000 ft. of blading in a direct drive, against 7720 ft. in the geared drive. The increase in efficiency is 16·1, 17, and 20 per cent. respectively for light cruisers, flotilla leaders, and torpedo-boat destroyers at full power; at one-fifth power the increases in efficiency are 16·5, 20, and 20 per cent. respectively.

MESSRS. THOMAS MURBY AND CO. are publishing shortly two books likely to interest geological readers, viz. "An Introduction to Palæontology," by Dr. A. Morley Davies, and "Petrographic Methods and Calculations," by Dr. A. Holmes. In the first-named work the "type-system" of Huxley is applied. A limited number of fossil species are described in detail, the relation of the structure to the animal's mode of life being pointed out, as well as the effects of fossilisation. Each such description is followed by a general account of the group of which the "type" is representative. The volume will contain appendices dealing with rules of nomenclature and methods of extracting and preserving fossils. In Dr. Holmes's volume the following subjects receive attention: Specific gravity and porosity of rocks—examination of crushed rocks and loose sediments—mineral analyses by heavy liquid, magnetic, and electrostatic methods—mechanical analysis of sands—preparation of thin sections and their examination by staining, micro-chemical, and other methods—chemical analyses of rocks and their interpretation—representation of analyses by diagrams—suggestions for the description of rocks.

MESSRS. W. HEFFER AND SONS, LTD., Cambridge, have just circulated a miscellaneous catalogue (No. 186) of secondhand books which will doubtless be of service to many readers of NATURE. The more strictly scientific portion contains 100 items ranging over most of the branches of scientific knowledge; a lengthier section gives particulars of works on folk-lore, mythology, psychical research, comparative religions, etc. The Sanskrit collection of the late Dr. A. F. R. Hoernle, comprising about 400 volumes, is also listed. The catalogue may be had upon application.

READERS of NATURE interested in biography and desirous of obtaining books relating to this subject at small cost should obtain a copy of Catalogue No. 400 just issued by Mr. F. Edwards, 83 High Street, Marylebone, W.1. The list is not particularly strong in science, but it contains lives of Charles Darwin, Sir Joseph Banks, J. J. Audubon, Thomas Bewick, Sir Colin Scott-Moncrieff, and others. There is also a section of works on genealogy and family history. The catalogue will be sent on request.

Our Astronomical Column.

APRIL METEORS.—Of April generally and its special meteoric display it can scarcely be said that they often possess features of striking interest from a spectator's point of view. The fact is that the spring months are usually all deficient in abnormal phenomena of this kind, and observers are sometimes sadly disappointed with the result of their observations; for if meteors from Lyra are absent or few, there is little else to engage the student, as meteors may fall not more abundantly than three or four in an hour.

There are periodic returns of grandeur attached to the Lyrids, but the uncertainty of the periodic time renders it a non-predictive feature. Hence the observer must needs take up his stand with a very doubtful prospect before him.

But the stream of Lyrid meteors has important historical associations, and the shower can boast of a known cometary parentage. These facts, combined with the possibility of a bright and abundant display in any year, lure observers to look for it with an interest and anticipation sometimes amply justified.

SPECTRUM OF η ARGÛS.—As Mr. Baxandall and Miss Cannon suspected changes in the spectrum of this interesting star, Dr. Joseph Lunt took two photographs in February and April, 1919. Each was exposed on three nights with a total exposure of nine hours. The spectrum consists mainly of bright lines; there are dark lines, but they cannot be identified with known lines, and may be merely interspaces between bright bands. The results for radial motion differ according to the lines employed. The enhanced iron lines give $-30{\cdot}7$ and $-28{\cdot}2$ km./sec. from the two plates. The chromium lines are in fair agreement with this, but the hydrogen bright lines give $+46{\cdot}5$ and $+48{\cdot}7$ km./sec., a difference of 77 km./sec. from the other lines. On the other hand, hydrogen dark lines give -19 excluding H_β, or -33 including it.

Dr. Lunt suggests in explanation the settling down of an extensive outer hydrogen atmosphere on to the central body. He refers to Mr. Innes's discovery of a faint companion, and notes that hitherto no certain sign of variable radial velocity has been detected. He emphasises the importance of keeping the star under constant watch, both visual and spectroscopic, as the light curve gives expectation of another brightening about the present time. The star is a curious link between novæ and variables, Miss Cannon noting a strong resemblance between its bright-line spectrum and that of Nova Aurigæ on 1892 February 17 (Monthly Notices, vol. lxxix.).

INFRA-RED SPECTRA OF NEBULÆ.—Investigations are being carried out at the Lick Observatory by Dr. K. Burns with the object of securing photographic plates of great sensitivity to infra-red radiations, and some plates prepared by him have been utilised by Mr. W. H. Wright for exploring the spectra of nebulæ in this region. In the Publications of the Astronomical Society of the Pacific, No. 185, Mr. Wright gives an account of his preliminary attempts in this direction, with the results obtained in the case of the planetary nebula N.G.C. 7027. The 36-in. refractor of the Lick Observatory was used with a single-prism spectrograph giving the rather small dispersion of 1 mm. to about 600 A.U. on the plate. The focus was not good in the region required, but fair definition was obtained between λ 6700 and λ 8500, and his photographs show four lines in the extreme red not previously reported. The corrected wave-lengths are given as approximately 7009, 7065, 7138, and 7325, and in addition to these lines there are others at λ 6678 and λ 6730 which have been measured previously with other apparatus.

Hydrographical Studies.[1]

HYDROGRAPHY is a backward science, and the very ocean, scientifically speaking, is a neglected field. Mr. J. Y. Buchanan, an oceanographer himself, tells us so in his new book of "Accounts Rendered":—"It seems almost incredible that the men of all nations, burning with scientific and exploring zeal, should have entirely overlooked, and apparently despised, this large portion of the world." Our *Challenger* Expedition had two faults: it cost a great deal of money, and it was done too well. It has led two generations of Englishmen to believe that the thing was done and need not be repeated, and must on no account be asked for again. Yet, in spite of this great old expedition of ours, and the various scientific exploring voyages of the *Travailleur*, the *Gauss*, the *Siboga*, the *Albatross*, the *Thor*, and all the rest which have followed it (in other hands than ours), we know perfectly well that our knowledge of the ocean, both physical and biological, is in its merest infancy. Its fauna we know as we knew that of the shore fifty years ago, a handful here, a handful there; of its physical and physico-chemical phenomena we know a great deal less.

Nor is this true only of the wide oceans. Twenty years ago we knew, to all intents and purposes, absolutely nothing of the hydrography of the North Sea itself with the one exception of its tides. Its temperatures and densities had never been mapped, their seasonal fluctuations (save at a few shore-stations) were unknown. Even in regard to the tides, and in spite of the great men who have devoted themselves to this favourite subject, we know that we have still a vast deal to learn in theory, and that in practice our tide-tables fall short of the accuracy which modern conditions demand. Things are beginning to mend. The University of Liverpool has established, not only a chair of oceanography, but also a special institute for the study of the tides; and, under the stimulus of international co-operation, a certain aspect of hydrography has come to be an intrinsic part of the scientific work of our fishery departments.

All this is to the good, though not yet nearly enough. The fishery departments are working on imperfect material, with inadequate staffs and still more inadequate laboratories; but better days are coming. Even in these hard times the work will go on, and under much better conditions than before, but we shall scarcely be satisfied! For the physical study of the sea is a very great thing indeed. Of its problems many are scarcely formulated, many others doubtless are still unforeseen. There is no end to them; they range, let us say, from the study of the tides to that of hydroxyl-ion concentrations, from the movements of the great ocean currents to the coefficients of absorption of the sun's rays in the surface-waters of the sea—nay more, they may involve the most fundamental questions of chemical physiology, in relation to the life and the nutrition of one grade of organisms after another. They call, or ought to call, for the widest physical and chemical knowledge and high mathematical skill. Not only must the officials of a department do their daily task, but still wiser and more learned heads must play their part.

There is not one of these problems which has not its practical side—its influence, direct or indirect, on the lives of fish and the lives of men. But the practical outcome of our knowledge lies, for the most part, a good long way off. The tanner, the dyer, or the brewer, the maker of soap or of glass, even the farmer and the gold-digger, come straight to the chemist with their troubles, for they have learned at last that it is worth their while; yet even now when they do so, as often as not the questions they put only suggest a new line of investigation, instead of finding an answer to hand. And chemistry is all but the oldest of the sciences, while hydrography is a thing of yesterday—or rather of to-morrow.

But I have left myself no room, after all, to discuss as they deserve those of Dr. Jee's papers published by the Department of Agriculture and Fisheries. They form a diligent and meritorious contribution to the necessary statistics of hydrography. They set forth fully and clearly (1) the variations of temperature and of salinity during a considerable number of years at the Seven Stones Lighthouse, a station of very obvious importance in the neighbourhood of the Scilly Isles; (2) the same phenomena on a cross-section of the English Channel, from the Isle of Wight to St. Malo; and (3) the same again for the surface-waters of the North Atlantic, in a particular area where warm currents appear to branch off for the ultimate supply of the southern and the northern portions of the North Sea. The data, which are very numerous, are furnished by captains of ships and the keepers of the lighthouse; and Dr. Jee's business has been to reduce to order, to analyse, and, above all, to discuss this large mass of observations. The phenomena so elucidated, and the deductions drawn from them, are too numerous to be discussed here.

On one curious point, and one only, we may say a word. Dr. Jee pays a good deal of attention to a favourite theory of certain meteorologists (Dr. Otto Pettersson among them) that there is a marked alternation of temperatures between the "odd" and the "even" years; that there is at least a *tendency* for the years of even number to be warmer than the odd. Dr. Jee finds considerable support for this theory in the surface-waters of the sea, but subject to curious limitations. He tells us that "it is a fact of undoubted significance that, for a very wide stretch of the Atlantic extending from the coast of Cornwall at least as far as 35° W., the November means are in the aggregate of substantially higher value in the years of even number, and that this value culminates in the area of maximal temperature. . . . This periodicity is a general feature of the waters of the Atlantic east of 35° W., and the persistence of its occurrence is amply demonstrated by the zonal means, which *regularly alternate* high in the November of an even year and low in the year following."

There is here, in short, some definite evidence adduced bearing on the important question of a regular two-year "pulse" of the Gulf Stream. But during other parts of the year exceptions become perplexingly numerous, and Dr. Jee himself tells us that "examination of the monthly means . . . shows that only in November do they exhibit any appreciable conformability to the odd and even rule." Even if the phenomenon were only clearly manifested in November (in this particular region), it might still be of great importance, and we should like to know a great deal more about it. The fact that we are left without a firm hold of the thing is not Dr. Jee's fault at all, but depends on the fact that he is still only able to deal in detail with a particular and limited area. A similarly detailed account of the surrounding areas would soon, I imagine, convince us whether we were dealing with a real phenomenon or not, and if it confirmed would begin to help to explain it.

D'ARCY W. THOMPSON.

[1] Board of Agriculture and Fisheries: Fishery Investigations. Ser. III. Hydrography. Vol. i., "The English Channel," Part ii.; Vol. ii., "Lightship Observations." Part i.; Vol. iii., "The Atlantic Ocean." Part i. By Dr. Edwin C. Jee. Hydrographer on the Staff of the Board. (H.M. Stationery Office, 1919.)

Public Health and Welfare.

THE forty-eighth Annual Report of the Local Government Board, containing the report of the Medical Department for 1918-19, is noteworthy in many respects. It is the last of what may justly be called a famous series; it is addressed, not, like its predecessors, to the President of the Board, but to the Minister of Health, and its introduction is written by the First Medical Officer of the Ministry of Health. Its contents are noteworthy too, dealing with matters that no one probably even ten years ago would have dreamed of seeing referred to in the Board's report, and with subjects that the early Medical Officers of the Board never thought of in relation to the work of the Board.

The introduction, written by Sir George Newman, takes the form of an interesting little historical note on the origin and growth of the Medical Department of the Local Government Board. To Sir John Simon, who was the first Medical Officer, to Dr. Seaton, who succeeded him, to Sir George Buchanan, to Sir Richard Thorne Thorne, to Sir William Power, and to Sir Arthur Newsholme, the last of the famous line, he pays due tribute. They were all great men in the eyes of the Public Health Service, but Sir John Simon was the greatest of them all. As the English Parliament is the mother of Parliaments, so English public health is the mother of all public health, and this is due almost entirely to Sir John Simon. That the English public health organisation is what it is to-day, the finest in the world and adopted as the model by every civilised nation, is largely thanks to him. This Sir George Newman acknowledges. He recognises also the greatness of the task before the new Ministry, and admits, though many hard things have been said of it, that the Local Government Board did work of tremendous value to the country and the people, and, "with all its limitations of machinery, proved itself a body in search of truth and having humanitarian ends." One precious possession it gave was the gift of method—"a method formulated by practice and experience, which consists of a combination of scientific work and common-sense administration, both associated with a wide and comprehensive vision." As to the future medical plans of the Ministry Sir George Newman has little to say except that steps have been taken to reorganise the medical arrangements by enlarging the staff and differentiating its functions. For the report itself Dr. G. S. Buchanan, Dr. R. J. Reece, and the Medical Inspectors of the Board are responsible, the first-named providing a general survey, as well as dealing, like each of his colleagues, with certain of the special conditions or subjects he was called upon to investigate during the year.

The bulk of the articles included relate to epidemic disease, and the outstanding feature of the year in this connection having been the pandemic of influenza, not unnaturally much space is devoted to this disease, the duty of reporting upon it being imposed upon Dr. Carnwath, who acted as secretary of the special committee set up to investigate the subject. This report contains an admirable and concise description of the outbreaks experienced here, and contains much most useful information with regard to the natural history of the disease. Reference is made to a number of investigations, bacteriological and epidemiological, carried out in various parts of the country during the epidemic. So far as the former are concerned, it cannot, as Dr. Carnwath states, "yet be stated that unequivocal conclusions have been reached." Serious doubt, however, was cast upon the claims of the bacillus of Pfeiffer, which for years had been held to be the causative organism, to continue to be so regarded. So far as epidemiological investigations were concerned, attention is directed to those carried out in Leicester by Dr. Arnold, one of the Medical Inspectors, and in certain public schools by Dr. Macewen, also a Medical Inspector. In Leicester Dr. Arnold made more or less of a general inquiry with the view of eliciting information as to age incidence, while in the schools Dr. Macewen went into the question of immunity in influenza. Neither investigator appeared to succeed in obtaining any information of practical value.

For a section of the report dealing with epidemic diseases associated specially with war conditions Dr. Buchanan is responsible; while Dr. Reece and Dr. MacNalty treat of encephalitis lethargica, the condition which the Press at first insisted upon regarding as botulism, and now persistently and, for some reason or other, jocularly refers to as "sleeping sickness." Of the war-diseases those specially dealt with are typhus and trench fever, malaria and dysentery. The fact that the first two are louse-borne diseases is stressed, and in regard to malaria it is pointed out that, though a few cases of indigenous origin have been brought to light, only in Kent was there any considerable spread of the disease. In the report on encephalitis lethargica Dr. Reece deals with prevalence, and Dr. MacNalty with the general features, of the disease. By both observers a number of references are made to instances of multiple cases in families and institutions, but both quite definitely hesitate to class the condition as infective. Dr. MacNalty's explanation of the sporadic distribution, that it belongs to the group of maladies, including such conditions as cerebro-spinal fever (spotted fever) and acute poliomyelitis (infantile paralysis), in which the agent is present commonly in the body and inactive until immunity breaks down, is one likely to be generally accepted.

Apart from reports upon diseases, there are some others dealing with more general matters. Of these, two calling for special reference are that by Dr. Wheaton on maternity and child welfare, and that on the work of the inspectors of food by Dr. MacFadden. Both chronicle advances and improvements. Dr. Wheaton shows that there is a steady increase in enthusiasm for welfare work amongst local authorities, as evidenced by the appointment of more and more health visitors and by the establishment of more and more centres, consultations, crèches, and day nurseries. The work of the food inspectors on behalf of the Army and the people, Dr. MacFadden states, was carried out with great activity, and, if it did nothing more, showed many openings for reforms. Of two important, long-overdue reforms, one has relation to the inspection of home-killed meat, which is inadequately done, because only just over a hundred local authorities have established public abattoirs, and much slaughtering is still done in private slaughterhouses. The other matter calling for attention is the supervision of places where food is prepared or stored. In most districts there are many places in which food is dealt with where the conditions are undoubtedly very bad. From time to time such places are discovered and efforts made to deal with them, but, as Dr. MacFadden shows, proper supervision is impossible for the reason that the powers granted by the Health Acts are inadequate and unsuitable for controlling them, and, more important still, the local inspectors are too few in number and too much overloaded with work of other kinds.

The whole report is exceedingly interesting, and in no sense inferior to those of former years. As it was the last of the series, no doubt those responsible for it desired to see it maintain the high level of excellence already attained, and they have succeeded.

Education of Engineers.[1]

THE report on the education and training of electrical engineers is a really important and instructive pronouncement. The industry is a comparatively new one, and the committee has been able to formulate recommendations in advance of the prejudices and customs of older branches of engineering. An attempt is made to lay down a uniform system for manual and technical workers of various grades, and it is pointed out that industry should be represented on all committees concerned with primary, higher, and technical education and with after-care and juvenile employment. The committee recognises four classes of apprentices, namely:

(1) *Trade Apprentices*, who enter works between fourteen and sixteen and are to be trained to become skilled workmen. They should be selected at an interview and given a trial period. The committee suggests that they should be placed under the supervision of a trained officer responsible for their selection, who should keep records of their progress.

(2) *Engineering Apprentices*, who enter works between the ages of sixteen and eighteen, chiefly from the higher secondary schools. These should be trained by practical experience and technical education, up to the age of twenty-one, for junior staff positions. Before entering works they should have attained a standard equivalent to that of a university matriculation examination. They should be selected after an interview and examination of school records, and appointed for a probationary period. Their practical training should be directed not so much to making them skilled workmen as to giving them a knowledge of various manufacturing processes and of design, testing, and workshop organisation. Their technical education should be continued during apprenticeship by part-time courses.

(3) *Student Apprentices*, preferably graduates in engineering, who enter the works between the ages of nineteen and twenty-two, and should be definitely trained for senior positions on the staff. The committee has reached the conclusion that the need for attracting men of ability makes it imperative, not only to abolish the premium system, but also to give during apprenticeship a maintenance allowance. Student apprentices should, if possible, have graduated in honours in engineering, and be taken systematically through a group of related departments.

(4) *Research Apprentices*.—Research is now an essential factor in industrial progress, and it is necessary to make definite provision for the training of research workers. University graduates who have shown special aptitude for scientific investigation should be selected, preferably from those who enter as student apprentices. In the last year of apprenticeship they should devote attention to investigations arising in practice, and then return to the university for a year of post-graduate work or obtain equivalent experience in a works laboratory.

The report concludes with a discussion of the need for more scholarships from primary to junior technical and secondary schools, and from these to the technological faculties of the universities; also for post-graduate research.

The report of the Institution of Naval Architects is briefer and less systematic. So far as it goes, it is on the same lines as the electrical report. It states that an apprenticeship, or at least a clear understanding binding on both sides between employer and lads entering works, is desirable. It suggests selection on results of school work and the need for a supervisor of lads learning their business. An appendix contains information obtained from the principal shipbuilding firms as to the opportunities afforded by them to lads entering the works, and especially as to the inducements held out to them to improve their educational equipment. An interesting part of the report is an account of the admirable system of training established by the Admiralty in H.M. Dockyards.

W. C. U.

1 "Education and Training for the Electrical and Allied Industries." Being a Report of a Committee of the British Electrical and Allied Manufacturers' Association. 64 pp. (London: Edward Arnold.)

Institution of Naval Architects. Report of the Committee on the Education and Training of Apprentices in Shipyards and Marine Engineering Works.

Tropical Control of Australian Rainfall.

IT would appear probable that the Australian continent, extending well within the tropical belt, of approximately symmetrical shape, and free from disturbance by large land masses, especially to the east and west, is the very best place to study the mechanism of tropical rain control. Certainly such a control, if proved and reduced to a system, should very greatly assist the forecasting of the all-important Australian rainfall. Bulletin No. 15 of the Commonwealth Bureau of Meteorology is devoted to a study of this subject by Mr. E. T. Quayle, Supervising Meteorologist of the Melbourne Bureau.

It must be admitted that the period dealt with, largely confined to the six years 1911–16, seems to demand very strong evidence to justify a general conclusion. This objection is partly met by an addendum dealing to some extent with longer periods—up to twenty-four years in one instance—but one would be inclined to wait for confirmation of the great improvement in rain-forecasting claimed by Mr. Quayle. His chosen "argument" is the minimum temperature in the tropical regions of Australia. If this is high, it may be attributed to cloudiness, extra humidity, or north-east wind, and of these three the second is suggested as the most important. In any case, the idea is that this high minimum, which is usually persistent for a few weeks at a time, causes such a flow of air to the southern parts of the continent that the approaching cyclonic "lows" are compelled to part with rain.

The stations on which Mr. Quayle lays most stress for his prediction are Darwin and Mein, the latter being on the north-east coast of Queensland. The influence does not travel directly southward, but Mein corresponds more closely with the Darling district of New South Wales and North Victoria; while Darwin corresponds with South Australia and, to a much less extent, with Western Australia. Inasmuch as the Darwin temperatures are inclined to follow those of Mein after about three days, the inference is that a longer forecast can be made from the Mein figures, or possibly from figures further eastwards in New Guinea.

Mr. Quayle gives figures to show that the average daily rainfall over the southern inland areas during the months April to October (the wheat-growing period) is more than twice as great during periods of high minimum at Darwin as during periods of low minimum. He considers that the slowness of the changes at Darwin justifies forecasts twenty days ahead. He discredits barometer readings as quite untrustworthy for this purpose. The behaviour of the lines of influence is not the same in dry years, but is nearly north to south in wet years. The exceptional years 1914 and 1916 happen to be included in the short period under consideration, and these certainly

show up in the diagrams connecting tropical temperatures with rainfall in New South Wales, South Australia, and the Upper Darling. Tinted diagrams are given showing for the whole continent the monthly departures from mean minimum temperature and mean rainfall, except for the summer months when rain is inappreciable. W. W. B.

Prehistoric Man and Racial Characters.

THE annual meeting of the Prehistoric Society of East Anglia was held on March 23 at the rooms of the Geological Society, the members of the Prehistoric Society being the guests of the Royal Anthropological Institute. The chair was taken by Prof. J. E. Marr, who delivered his presidential address. His subject was "The Relationship of the Various Periods of Prehistoric Man to the Great Ice Age." He regarded the existence of Pliocene man in East Anglia as proved, and also accepted Mr. Reid Moir's views that the "Mid-Glacial" implements of Ipswich were of Lower Palæolithic age, and that Lower Mousterian implements were incorporated in the Chalky Boulder Clay. He brought forward confirmatory evidence of this from the drainage area of the Great Ouse basin, and regarded the Chelles-Archeul period as intermediate between the two glaciations marked by the Cromer Till and Chalky Boulder Clay respectively. After the formation of the latter clay there seemed to be a recession of ice followed by a re-advance in Magdalenian times, but, as O. Holst argues, this need not indicate an inter-glacial period. If there was a Pliocene glaciation in this country, the evidence seems to point to two succeeding glaciations in Pleistocene times, the last being marked by a period of ice-recession in Aurignac-Solutré times, in which case Lower Palæolithic man lived between the second and third glaciations, and the men of the periods from Mousterian to Magdalenian inclusive during the period of the third glaciation, with its interval of temporary ice-retreat. The questions of earth movements and diversions of river drainage during the periods under consideration were briefly considered.

The presidential address was followed by a paper by Mr. H. Dewey entitled "Flat-based Celts from Kent, Hampshire, and Dorset," dealing with a group of implements that were found lying on the surface in various parts of those counties. They differ in outline from one another, but agree in possessing flat bases. Some of the bases were produced by the removal of a single flake, and retain the terminal cone of percussion. Others resulted from the removal of a number of flakes from the sides of the implement, with the obvious intention of making the base level and flat. Most of them are pointed at one end, and have a horizontal chisel-edge at the opposite extremity. In their general form they resemble fat slugs or caterpillars. Sir John Evans figures some examples. Their age is unknown, but would by most archæologists be assigned to the Neolithic period. The discovery, however, in gravels of similar forms renders hasty classification hazardous.

A very fine collection of stone implements from Grime's Graves was exhibited by Dr. A. E. Peake.

In the evening, at a joint meeting of the Royal Anthropological Institute and the Prehistoric Society of East Anglia, Sir Everard im Thurn in the chair, Prof. Arthur Keith gave an address entitled "How Far can Osteological Characters Help in Fixing the Antiquity of Human Remains?" Certain characters of the nose, orbit, palate, and lower jaw have never been seen in British skulls belonging to any period older than the Roman occupation, and become increasingly frequent as we approach the present time. These characters consist of (1) the "margination" or flanging of the lower border of the nasal opening; (2) the retreat of the incisor part of the alveolus of the upper jaw, leaving the nasal spine and lower margin of the nose as an overhanging jib and ledge; (3) the reduction in size of the malar bone, leading to the lower margin of the orbit being depressed in a downward and outward direction; (4) the arching of the upper margin of the orbit; and (5) a reduction in the development of the angular part of the lower jaw. If these characters are found in a British skull, the conclusion may be drawn with certainty that it is of a Roman or post-Roman date. Contraction of the palate was also a character unknown in Britain until a Late Celtic date. The rounded type of head found in graves of the beaker period in Britain were not known in England before Late Neolithic times, but pure representations of this type of skull are still to be seen in our modern population. A type of skull was found in the deeper deposits of the Thames bed which were identical with the skulls found under the Neolithic pile-dwellings of the Swiss lakes. So far as our knowledge of Neanderthal man will take us, we are justified in regarding him as confined to the Mousterian period of European culture. If any characteristic part of the skull or skeleton of this race were discovered in an undisturbed deposit, that deposit may be safely assigned to the period of the Mousterian culture.

A College of Tropical Agriculture.[1]

A STRONG Committee was appointed in August last to report to the Secretary of State for the Colonies upon the desirability of establishing a tropical agricultural college in the West Indies and upon matters connected therewith. Its report has just appeared, and is one which may be fraught with important results for the future of agriculture in our extensive tropical Dependencies, more especially in the West Indies, where, thanks to the work of the Imperial Department of Agriculture, general agricultural prosperity has in the last two decades been placed upon a much sounder footing. It is significant of the trend of modern practice that a Committee like this, composed of planters, commercial magnates, and scientific men, as well as administrative officials, should have reported unanimously in favour of the establishment of such a college.

The selection of a site affords much ground for discussion, and after careful consideration Trinidad was chosen as being near to the headquarters of the Imperial Department, and having good communications with the other islands, besides a great variety of crops in cultivation. Incidentally, in view of the growing importance of oil in that colony, a subsidiary school of oil technology is proposed. A postscript to the report, however, suggests that the last word may not yet have been said on the subject of location.

A governing body of about twenty-three, representing all the different interests involved, is proposed, and a staff of ten professors (agriculture, mycology, entomology, agricultural chemistry, organic chemistry, agricultural bacteriology, agricultural and physiological botany, genetics, sugar technology, and agricultural engineering and physics), besides lecturers in stock and veterinary science and in bookkeeping.

Considerable interest attaches to a curriculum sug-

1 West Indies. Report of the Tropical Agricultural College Committee. (H.M. Stationery Office, 1920.) Price 2d.

gested by Sir Francis Watts, the Imperial Commissioner of Agriculture for the West Indies, with which the Committee expresses itself as in general agreement. It includes (*a*) a junior course of two or three years, suitable for boys leaving the Colonial secondary schools and intending to follow ordinary agricultural pursuits, usually in the colonies from which they have come; (*b*) a senior course of similar instruction of not less than four years; (*c*) a two years' course, practically the same as the last two years of the previous course, for students who have already undergone a training in agriculture in a university or agricultural college, and thus intended to meet the case of students going out from Europe to work at agriculture in the tropics, whether on their own account or as officials; and (*d*) post-graduate study of special agricultural subjects, such as mycology or genetics, or the study of special crops such as sugar or cacao. It is incidentally recommended that a special school for the study of sugar should be established.

This is a very interesting and practical programme, and it is to be hoped that it may soon be translated into reality. The only criticism that occurs to one is to ask whether it is not just a trifle too ambitious for a commencement and too great a change from the customary methods of learning the work of tropical agriculture, and whether it may not tend to make the tropical student at least, and especially him who must work under seniors trained in the old way, a trifle unpractical. Great care will have to be exercised to make the instruction as practical as possible, and for this reason we note with pleasure the insistence upon making the new college work as much as possible in connection with the Imperial Department.

Finally, it is suggested that a fund of at least 50,000*l.* be raised by private subscription for the establishment of the college, and that for maintenance annual contributions be invited from the various Colonial Governments, and also from the Imperial Government, to which the proper development of the great tropical lands of the Empire is of such paramount importance.

Duplex Wireless Telephony.

ANOTHER of the interesting series of papers on wireless developments connected with the war before the Wireless Section of the Institution of Electrical Engineers was that of Capt. P. P. Eckersley, read on March 17, describing experiments by Major Whiddington and himself on the application of duplex wireless telephony to aircraft. The advantages of being able to converse freely and simultaneously both ways, as is done in a true duplex system, over using a change-over switch are obvious, but the electrical difficulties in the way of its successful accomplishment are considerable. The main problem lies in devising a form of circuit which will protect the receiver, without detriment to its efficiency, from the effects of the relatively powerful high-frequency alternating currents generated by the transmitter.

Two general principles have been adopted. In one, two separate aerials with different frequencies for transmission and reception are placed at right angles and spaced more than a quarter of a wave-length apart. In the other, which may employ a single aerial, the "earth" connection is split, and the branches are tuned so that the transmitter current passes through one and the receiver current through the other. Both these systems present difficulties, and have been used only to a limited extent. A compromise system, in which the transmitter oscillates only when the operator is actually speaking, with what is called a "quiescent aerial" was also experimented with, but the speech was found to be much improved by allowing a small permanent oscillation, increased sympathetically with the voice. Such an arrangement, called an "augmented oscillation transmitter," has certain practical advantages, as well as incidentally presenting some interesting theoretical points, but forms only a "partial duplex" system, as an interruption during speaking cannot be heard. The author's experiments have progressed well on the way towards the evolution of a practical and trustworthy system of duplex wireless telephony for aircraft, and form a valuable groundwork for future development.

University and Educational Intelligence.

ABERDEEN.—At the spring graduation ceremony Principal Sir George Adam Smith announced a gift of 20,000*l.* from Sir Thomas Jaffrey, head of the Aberdeen Savings Bank, for the establishment of a chair in political economy in the University. There has been a lectureship in this subject for a number of years.

The University has just conferred on Sir Jagadis Chandra Bose the honorary degree of LL.D.

BIRMINGHAM.—Mr. Arthur R. Ling, consultant in applied chemistry and lecturer in brewing at the Sir John Cass Institute, London, has been appointed to the Adrian Brown chair of brewing.

A bronze memorial tablet in memory of the late Prof. Adrian Brown has been erected in the Brewing School by past students.

A gift has been received from the Asiatic Petroleum Co. of a model drilling equipment, which will be exhibited at the forthcoming Petroleum Exhibition at the Crystal Palace.

Mr. Frank Shaw has been appointed assistant lecturer in electrical engineering, and Mr. Raymond B. H. Wyatt lecturer in bacteriology.

CAMBRIDGE.—Mr. G. E. Briggs, St. John's College, formerly University Frank Smart student in botany, has been elected to the Allen scholarship.

The new Statute of the University which gives the degree of Ph.D. to research students in the University is the result of the work of a syndicate appointed in December, 1917, "to consider the means of promoting educational collaboration with the universities of the Empire and foreign universities." The chief points of interest in the proposed regulations for working the Statute are as follows:—Research students, who must be at least twenty-one years of age on admission, must have graduated at some university (Cambridge itself included), or must satisfy the University as to their general educational qualifications. Before admission their proposed course of research must have been approved, and they must show that they are qualified to enter upon the course proposed. Students must pursue research for three years before submitting for a degree the dissertations embodying the results of their research. Those who are graduates of Cambridge need only spend one of the three years at Cambridge; others must spend at least two years at Cambridge. The remainder of the time must be spent at some place or places of study approved by the University. Research students who are candidates for degrees at other universities and who spend at least two terms in Cambridge may receive certificates of regular study and industry to cover the time spent in Cambridge. A Board of Research Studies is to be formed to supervise the carrying out of the new scheme. The proposals show a welcome movement away from the old spirit of "splendid isola-

tion" which has in the past too often been attributed to Cambridge University.

LONDON.—Mr. William Neilson-Jones has been appointed as from May 1 next to the University chair of botany tenable at Bedford College. Mr. Neilson-Jones was foundation scholar of Emmanuel College, Cambridge, and obtained a first class in part i. of the Natural Sciences Tripos and a second class in part ii. (Botany). He has carried out research work at Cambridge and for the Health of Munition Workers Committee of the Medical Research Committee. In 1909 Mr. Neilson-Jones was appointed lecturer in botany at University College, Reading, and in 1913 assistant lecturer in botany at Bedford College; since 1916 he has been head of the department at this college.

It has been resolved by the Senate that the following posts should be established in connection with the recent benefaction of 150,000*l.* made by the Sir Ernest Cassel Trustees:—(1) Sir Ernest Cassel chairs of accountancy and business methods, of commercial and industrial law, and of banking and currency; (2) three Sir Ernest Cassel readerships in commerce, dealing specially with (*a*) foreign trade, (*b*) the organisation of industry and trade in the United Kingdom, and (*c*) the influence of tariffs and taxation respectively; and (3) three University lectureships in commerce, with special reference to commercial geography, business methods, and transport respectively.

An offer from the Worshipful Company of Vintners to provide, for a period of five years in the first instance, two scholarships, each of the annual value of 150*l.*, for students for the degree in commerce has been accepted by the Senate with thanks. The thanks of the Senate have also been accorded to the relatives of the late Capt. G. D. Harvey-Webb, formerly of University College, for their gift of his collection of shells for the department of zoology at that college; and to Prof. Graham Wallas for his gift of another collection of shells for the same department to supplement that of Capt. Harvey-Webb.

The following doctorates have been conferred:—*D.Sc.*: Mr. F. J. North, an external student, for a thesis entitled "On Syringothyris, Winchell, and Certain Carboniferous Brachiopoda referred to Spirifera, d'Orbigny." *D.Sc.* (*Economics*): The Rev. A. W. Parry, an external student, for a thesis entitled "Education in England in the Middle Ages."

Keddey Fletcher-Warr studentships, each of the value of 300*l.* a year for three years, have been awarded to Dr. Agnes Arber, for post-graduate research in botany, and to Miss Margaret McFarlane, for post-graduate research in psychology. These studentships were established under the benefaction founded by Mrs. du Puy Fletcher.

The annual report of University College has just been issued. The total number of students for the session 1918–19 was 2048, an increase of 977 on the previous year. This increase took place after the armistice, and mainly in January, 1919, and consisted almost exclusively of ex-Service men. The total revenue of the college for the year 1918–19 was 75,781*l.*, of which 26,304*l.* was from fees. The total expenditure was 77,824*l.*, causing a deficit of 2210*l.* This deficit arises from the increase in salaries that has become necessary, and generally from the increased cost of running the college. The report contains a summary of the main work of the year. The new departments of Scandinavian studies and of Dutch studies have already made a good start. The new school of librarianship, which has been instituted with money provided by the Carnegie Trust, and of which Sir Frederic Kenyon is the honorary visitor, began with an enrolment of eighty-eight students. The student body included 253 post-graduate and research workers. The fifth appendix of the report gives a list of the papers and publications issued by them during the past year. Nine new fellows are elected to the college biennially. The list for this year is remarkable in that it includes the first Chinaman to be elected to the fellowship and two distinguished members of the Slade School of Fine Art. The full list of fellows is as follows:—F. J. Fitzmaurice Barrington, W. C. Clinton, Ethel M. Elderton, Brig.-Gen. Sir Alexander Gibb, his Excellency Yuen Hsu, Augustus E. John, Major Sir William Orpen, Dr. T. H. C. Stevenson, and Dr. Ethel N. Thomas.

MANCHESTER.—In connection with the Ellis Llwyd Jones lectureship for training teachers of the deaf recently established at the University through the benefaction of Sir James E. Jones, the Carnegie United Kingdom Trust has granted to the University the sum of 2500*l.* for the foundation and maintenance of a library for deaf education. It is intended to make this library as comprehensive as possible, and to include in it works dealing with the various systems of teaching the deaf, speech training, psychology of speech and of hearing, phonetics, acoustics, anatomy, physiology, and diseases of the ear. The books are to be available to all individuals, societies, and institutions throughout the United Kingdom interested or concerned in the education and training of the deaf, and they will be ready for consultation and borrowing immediately after Easter. No charge beyond the cost of carriage is to be made for the loan of books, but intending borrowers will be required to fill in a form of application to be obtained from the Librarian, Library for Deaf Education, The University, Manchester.

OXFORD.—The Romanes lecture for 1920 will be delivered by the Very Rev. W. R. Inge, honorary fellow of Hertford College, Dean of St. Paul's, on Thursday, May 27. The subject will be "The Idea of Progress."

Societies and Academies.

LONDON.

Aristotelian Society, March 8.—Prof. Wildon Carr in the chair.—M. **Ginsberg**: Is there a general will? The term "general will" has been used in many different senses. Especially important are the view of Wundt based on an analysis of the mutual implications of presentation and will, and leading to a theory of a series of will-unities of varied complexity, and the doctrine of a "real" will worked out by Prof. Bosanquet and other idealists. All the theories, in varying degrees, involve a confusion between the act of willing, which must always be individual, and the object of will, which may be common. Prof. Bosanquet's view in particular is based upon a hypostatisation of contents, and a tendency to deny the reality of acts, of experience. Generally, in so far as the psychological forces operative in society are general they are not will, and in so far as there is present self-conscious volition it is not general. The State and other associations exhibit a kind of unity, but this unity is a relation based on community of ideals and purposes, and must not be spoken of as a person or will. For the purpose of social theory, what is required is not a common self, but a common good. The latter is an ideal and not an existent, and must not be identified with a general will.

Mineralogical Society, March 16.—Sir William P. Beale, Bart., president, in the chair.—A. **Russell**: The occurrence of cotunnite, anglesite, leadhillite, and galena on fused lead from the wreck of the fireship *Firebrand*, Falmouth Harbour, Cornwall. The specimens were obtained in 1846 from the wreck of the fireship *Firebrand*, which was burnt in Falmouth Harbour about the year 1780. They were found under the lead pump, most of which appeared to have been melted and mixed with charcoal, and consist of slag-like masses of lead, which has evidently been fused, and upon the surface and interstices of which are numerous well-defined and brilliant crystals of cotunnite and anglesite, and more rarely small crystals of leadhillite and galena. The cotunnite crystals, which are colourless and transparent, with brilliant faces, are nearly always elongated in the direction of the *a* axis, and attain a length of 3 mm. The habit is somewhat variable owing to the very unequal development of the faces. The forms observed were 010, 001, 021, 011, 012, 101, 111, and 112. The anglesite crystals are of rectangular habit, and exhibit the forms 100, 001, 110, 102, 122, and 113. The leadhillite crystals, thin six-sided plates in shape, are of a brown colour, and show the forms 101, 201, $\bar{1}01$, $\bar{2}01$, 112, 111, $\bar{1}12$. and $\bar{1}11$. The galena occurs in minute cubo-octahedra. An occurrence of cotunnite formed under almost exactly similar conditions has been described by A. Lacroix. Similar occurrences of lead oxychlorides at Laurium and of leadhillite in Roman slags from the Mendip Hills were referred to.—W. Campbell **Smith**: Riebeckite-rhyolite from North Kordofan, Sudan. A rock found by Dr. C. G. Seligman at the base of Jebel Katul, 350 miles south-west of the Bayuda volcanic field, was described.—Dr. G. T. **Prior**: The meteoric iron of Mount Ayliff, Griqualand East, South Africa. This meteoric iron, found about 1907, is a coarse octahedrite similar in character to Wichita County (Brazos River) and Magura (Arva). On polished and etched surfaces it shows nodules of graphite and troilite, and abundant cohenite crystals arranged parallel to the octahedral bands. It contains about 7 per cent. of nickel.

Books Received.

British Antarctic Expedition, 1910–1913. Meteorology, vol. i., Discussion, by Dr. G. C. Simpson. Pp. x+326+v plates. Vol. ii., Weather Maps and Pressure Curves, by Dr. G. C. Simpson. Pp. 138+23 plates. (Calcutta: Thacker, Spink, and Co.)

The Theory of Determinants in the Historical Order of Development. By Sir Thomas Muir. Vol. iii.: The Period 1861 to 1880. Pp. xxvi+503. (London: Macmillan and Co., Ltd.) 35*s*. net.

Inbreeding and Outbreeding: Their Genetics and Sociological Significance. By Drs. E. M. East and D. F. Jones. Pp. 285. (Philadelphia and London: J. B. Lippincott Co.) 10*s*. 6*d*. net.

The Physical Basis of Heredity. By Prof. T. H. Morgan. Pp. 305. (Philadelphia and London: J. B. Lippincott Co.) 10*s*. 6*d*. net.

Psychology from the Standpoint of a Behaviorist. By Prof. J. B. Watson. Pp. xiii+429. (Philadelphia and London: J. B. Lippincott Co.) 10*s*. 6*d*. net.

The Theory and Practice of Aeroplane Design. By S. T. G. Andrews and S. F. Benson. Pp. xii+454. (London: Chapman and Hall, Ltd.) 15*s*. 6*d*. net.

Science and Theology: Their Common Aims and Methods. By F. W. Westaway. Pp. xiii+346. (London: Blackie and Son, Ltd.) 15*s*. net.

Monarch: The Big Bear of Tallac. By E. Thompson Seton. Pp. 215. (London: Constable and Co., Ltd.) 7*s*. 6*d*. net.

Animal Heroes. By E. Thompson Seton. Pp. 363. (London: Constable and Co., Ltd.) 8*s*. 6*d*. net.

Farm Management. By J. H. Arnold. Pp. vii+243. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 7*s*. 6*d*. net.

Cement. By B. Blount. Assisted by W. H. Woodcock and H. J. Gillett. Pp. xii+284. (London: Longmans and Co.) 18*s*. net.

Diary of Societies.

TUESDAY, APRIL 6.

RÖNTGEN SOCIETY (at Medical Society of London), at 8.15.

WEDNESDAY, APRIL 7.

ROYAL UNITED SERVICE INSTITUTION, at 3.—Lieut. W. S. King-Hall: The Submarine and Future Naval Warfare.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.

THURSDAY, APRIL 8.

OPTICAL SOCIETY, at 7.30.

INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates Section), (at 28, Victoria Street), at 8.—W. D. Pile: The Use of Benzol.

FRIDAY, APRIL 9.

ROYAL ASTRONOMICAL SOCIETY, at 5.

CONCRETE INSTITUTE, at 6.—T. J. Clark: The Uses of Concrete.

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—C. H. Woodfield and Others: Discussion on Cranes: Their Use and Abuse.

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